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DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO

WALTER W. BRADLEY State Mineralogist

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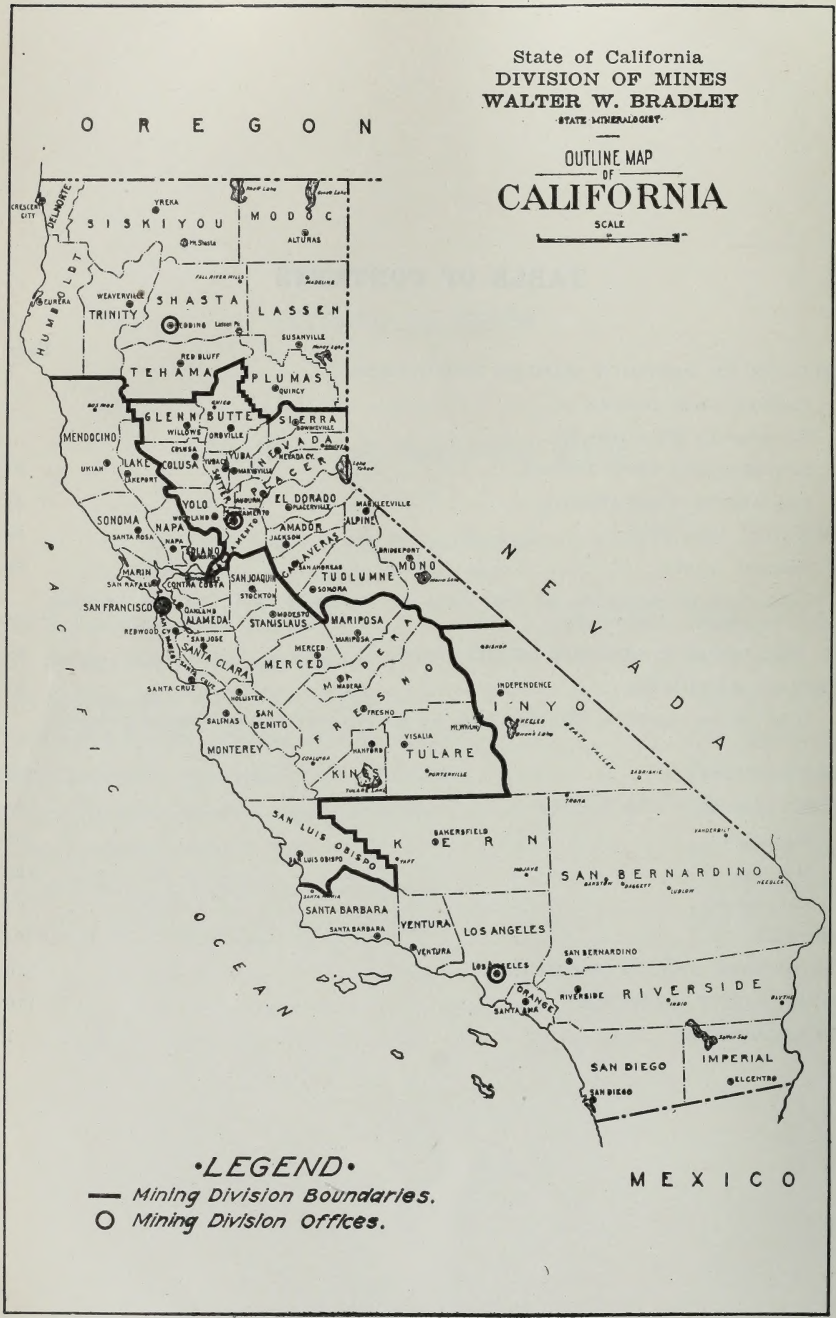
TABLE OF CONTENTS

Page
REPORTS OF DISTRICT MINING ENGINEERS ---- 1
  Redding Field District ---- 1
  Sacramento Field District ---- 1
  San Francisco Field District ---- 24
  Los Angeles Field District ---- 49
GEOLOGIC BRANCH ---- 50
  Current Notes ---- 50
  Geological Investigation of the Clays of Riverside and Orange Counties, Southern California ---- 51
OIL FIELD DEVELOPMENT OPERATIONS ---- 88
SPECIAL ARTICLES ---- 94
  Information regarding Mining Loans by the Reconstruction Finance Corporation ---- 95
ADMINISTRATIVE ---- 100
MINERALS AND STATISTICS ---- 101
  Statistics ---- 101
  Museum ---- 102
  Laboratory ---- 102
LIBRARY ---- 104
PRODUCERS AND CONSUMERS ---- 110
EMPLOYMENT SERVICE ---- 110
PUBLICATIONS ---- I



State of California
DIVISION OF MINES
WALTER W. BRADLEY
STATE MINERALOGIST

OUTLINE MAP
OF
CALIFORNIA

SCALE

•LEGEND•
— Mining Division Boundaries.
○ Mining Division Offices.

OREGON
NEVADA
PACIFIC OCEAN
MEXICO
DEL NORTE
CRESCENT CITY
SISKIYOU
YREKA
Mt. Shasta
MODOC
ALTURAS
HUMBOLDT
EUREKA
TRINITY
WEAVERVILLE
SHASTA
REDDING
Lassen Pk.
LASSEN
SUSANVILLE
TEHAMA
RED BLUFF
PLUMAS
QUINCY
MENDOCINO
UKIAH
GLENN
WILLOWS
BUTTE
OROVILLE
CHICO
SIERRA
DOWNIEVILLE
NEVADA
NEVADA CY.
LAKE
LAKEPORT
COLUSA
YUBA
MARYSVILLE
SUTTER
PLACER
AUBURN
Lake Tahoe
YOLO
WOODLAND
EL DORADO
PLACERVILLE
SACRAMENTO
ALPINE
MARKLEEVILLE
SONOMA
SANTA ROSA
NAPA
SOLANO
AMADOR
JACKSON
CALAVERAS
SAN ANDREAS
MARIN
SAN RAFAEL
CONTRA COSTA
SAN JOAQUIN
STOCKTON
TUOLUMNE
SONORA
MONO
BRIDGEPORT
SAN FRANCISCO
OAKLAND
ALAMEDA
SAN MATEO
REDWOOD CY.
STANISLAUS
MODESTO
MARIPOSA
SAN JOSE
SANTA CLARA
MERCED
MADERA
SANTA CRUZ
HOLLISTER
SAN BENITO
SALINAS
MONTEREY
FRESNO
INYO
INDEPENDENCE
BISHOP
Mt. Whitney
DEATH VALLEY
KINGS
HANFORD
COALINGA
Tulare Lake
TULARE
VISALIA
PORTERVILLE
SAN LUIS OBISPO
KERN
BAKERSFIELD
TAFT
MOJAVE
TRONA
SAN BERNARDINO
BARSTOW
DAGGETT
LUDLOW
NEEDLES
VANDERBILT
SANTA BARBARA
SANTA MARIA
VENTURA
LOS ANGELES
ORANGE
SANTA ANA
RIVERSIDE
INDIO
BLYTHE
Salton Sea
SAN DIEGO
IMPERIAL
EL CENTRO

PREFACE

The Division of Mines (formerly State Mining Bureau) is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

As a progressive step in advancing the interests of the mineral industry, and as permitting earlier distribution to the public, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923. Owing to a lack of funds for printing this was changed to a quarterly publication, beginning in September, 1923. For the same reason, beginning with the January, 1924, issue, it became necessary to charge a subscription price. This covers approximately the cost of printing.

Pages are numbered consecutively throughout the year and an index to the complete report is included annually in the closing number.

Beginning with the 1930 issues, the activities and progress of the Geologic Branch are recorded also in these quarterly chapters. The important part that geology plays in the economic development of our mineral resources is further recognized in the change of title from *Mining in California* to CALIFORNIA JOURNAL OF MINES AND GEOLOGY, beginning with the January, 1933, chapter.

While current activities of all descriptions are covered in these chapters, the practice of issuing from time to time technical reports on special subjects will be continued as well. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters are subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Division of Mines is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

Types of Reports

In general the reports presented in these chapters are grouped into three classes:

1. Mines and mineral resources of a given county (describing kind, character, distribution and extent of development).
2. Specific economic and industrial mineral products (listing and describing the resources over the entire State of a given mineral substance, e.g. feldspar).
3. Geological reports on specific areas (recording results and conclusions, with maps, derived from field studies; and tied in with economic possibilities, and developments).

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REPORTS OF DISTRICT MINING ENGINEERS

In 1919–1920 the Mining Bureau was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district, working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively. This move brought the office into closer personal contact with operators, and it has many advantages over former methods of conducting field work, including lower traveling-expense bills for the Bureau's engineers. In 1923 the Redding and Auburn field offices were consolidated and moved to Sacramento.

The Redding office was reestablished in 1928, and the boundaries of each district adjusted. The counties now included in each of the four divisions and the locations of the branch offices are shown on the accompanying outline map of the State. (Frontispiece.)

Reports of mining activities and development in each district, prepared by the District Engineer, will continue to appear under the proper field division heading.

REDDING FIELD DISTRICT

Chas. V. Averill, Mining Engineer

There is no report from the Redding Field Division. Mr. Chas. V. Averill, District Mining Engineer, is engaged on investigations for a special report upon the gold resources of Siskiyou County.

SACRAMENTO FIELD DISTRICT

REVIEW OF GOLD MINING IN EAST-CENTRAL CALIFORNIA, 1934

By C. A. Logan, District Mining Engineer

The revival of interest in gold mining in California, which was first concretely shown in an increased output in 1930, has continued unabated during 1934 with added stimulation lent by the stabilization of the price of gold, for the time being at least, at $35 an ounce. Persistent and plausible rumors that the price would be further increased to $41.34 an ounce have so far proved premature. As the depression enters its sixth winter, more and more thoughtful investors are turning to an investigation of gold mining possibilities, particularly in east-central California, the most productive and extensive gold mining region in the United States. This great belt of metamorphic rocks overlying the granite on the western slope of the Sierra Nevada has a length of over 200 miles and a width of 25 to 50 miles. After 85 years of mining, it is still true that many opportunities remain here for finding orebodies.

The number of new and resumed mining ventures that have been started in the past two years has been so great that all can not be mentioned in a short review. The increased gold price has done several things for California gold mining. Mines with low-grade ores which had to close on account of advanced commodity and labor costs and stationary gold price following the war, are again being opened. Long-established mines, that have lately reached great depths (5250 ft. vertically in Amador County and 9000 ft. inclined depth in Nevada County, for example) have been given added hope for the future, in that the new gold price helps to offset increasing costs due to such depth and permits mining ore of lower gold content. The areas of the principal dredging fields have been increased and the imminent prospect of early exhaustion has been replaced by promise of longer life. Many small-scale dredging and other shallow placer mining ventures have been started. Improvements in the technology of mining and treating large, low-grade shallow orebodies have also helped to induce large and experienced operators to begin work on this class of mines. The most disquieting feature of the picture is the labor trouble which has closed the principal mines of the Mother Lode in Amador County during the last quarter of 1934. 'Depression miners,' who contributed materially to the gold output in 1932 and 1933, continued to make thousands of small sales of gold. Some 12,000 people with little or no capital or previous experience have been devoting part time to such work during the past three years.

Hand sluicing of top gravel on Yuba River near Smartville, Yuba County.
Photo by Walter W. Bradley

The total gold production of California in 1934 is estimated at 709,963 fine ounces. Although the price paid for gold during January, 1934, ranged from $34.06 to $34.45 a fine ounce, and the present price of $35 an ounce was not established until February 1, it is likely that most of the sales made in 1934 were at the latter figure. The principal producing counties have been Nevada, Sacramento, Amador, Yuba, Sierra, El Dorado, Calaveras and Mariposa. The greatest relative increases have come probably in the first two named, and companies in these two counties have also enjoyed substantial operating profits.

Very little field work has been possible from the Sacramento office of the division during the past two years because of lack of funds. There has also been a greatly increased demand from the public for technical information and advice concerning gold mines and mining. Such time as has been available from that service has been devoted to completing a bulletin on the Mother Lode mines in El Dorado, Amador, Calaveras, Tuolumne and Mariposa counties. This should be ready for sale about February 10. The widespread and important developments along that lode are therefore not mentioned here, as they have been covered in detail in the above book. It may be said, however, that several hundred men have been put at work on Mother Lode mines in El Dorado, Mariposa and Calaveras counties, where the advance in the gold price has permitted reopening of mines with low-grade ores.

SIERRA COUNTY

The *Sixteen to One Mine* has remained the principal gold quartz producer, although considerable activity has been shown in the reopening and prospecting of other quartz mines in the Alleghany district, notably the *Oriental* and *Kenton* mines. Both of these have reported discoveries of 'high grade.' Electric power was brought to the Oriental late in the year and three air compressors and other equipment installed. Ore has been milled from the 1200-ft. level and a moderate output reported. Considerable work has been done during the past two years at the Kenton, both on the surface and underground. The electric power line was extended from the Oriental to the Kenton and a bunkhouse and other buildings erected. Ten stamps were erected, giving 18 in all. A large amount of money has been spent the past two years on the *Plumbago,* formerly one of the principal mines of the district. In 1934, the *El Dorado* group was made part of a consolidation with the Plumbago, which made some production late in 1934.

Rehabilitation of the *Alaska Mine* at Pike City was started during the summer. This was a notable producer in early days and was worked up to the time of the World War.

Prospecting has been going on at some 25 properties in the Downieville region. Among these, the *City of Six Quartz Mine* has installed a small mill to crush ore which has accumulated over a period of many years of conservative work. The *Telegraph Mine,* for a long time an interesting puzzle to mining men, has been equipped with a Diesel power plant. This old mine was long ago a good producer of placer gold from lava-capped gravel benches. As in the case of several other mines in this county, gold-bearing quartz was found in the course of gravel mining, and has attracted several companies though none have succeeded so far in finding any large amount of ore.

Sierra Nevada Mining Corporation has been employing 29 men in prospecting the *Bunker Hill Drift Mine* and adjacent ground near the Sierra-Plumas counties line about 14 miles northeast of La Porte. This company has been sinking winzes in an adit 3000 ft. long which had been run across a channel by previous operators. Pay gravel is reported in a crosscut run 200 ft. from the bottom of a winze 19 ft. deep. This is said to be on one side of the trough of the channel. About 60 tons of gravel daily was reported being produced in August, in the course of development, with very encouraging returns. At that time the channel had been followed about 90 ft. The property is equipped with 65-h.p. gas engine, electric generator, 200-cu. ft. air compressor, drill sharpener and power saws and there are several buildings.

Several permits for hydraulic mining have been issued to companies in this county. Most important of these are two mines in the Scales district.

Scales Placer Mining Company is engaged in equipping the *Cleveland* and other hydraulic mining claims (formerly *Neocene Placer Mining Company*) at Scales. This property has been worked in the past, but short water seasons and large boulders have been the worst impediments to success. The bank in the old pit is 50 to 150 ft. high, and contains many large boulders in fine gravel and volcanic ash, at times tight or slightly cemented. Work on a new ditch system was started during the late summer, and steel rails were being delivered to line the sluices. From 2000 to 3000 miners inches of water should be available in a favorable year. Storage for the tailing from this mine is to be behind Bullards Bar dam. A permit to hydraulic 5,000,000 cubic yards of gravel has been issued.

A permit has been issued to hydraulic at the *Poverty Hill Mine,* next northwest of Scales.

F. J. Joubert, owner and operator of *Depot Hill Hydraulic Mine,* which has been in operation longer than any other of the kind in the State, also has a license to operate the Indian Hill Mine, a few miles north of the former.

Licenses have also been issued for hydraulic mining at the following:

American Hill, O. K. Group and *Halana* (Gibsonville district), *Horse Valley* (Camptonville district), *St. Louis* and *Howland Flat Mines* and *Pacific Mine* (northwestern corner of county), *Arctic Placer* (Sierra City district), *Mac Kenzie* and *Best Chance* (Downieville district), *Silver* and *Sugar Pine* (Brandy City district), *True Grit* and *Grizzly Hill Mines.*

M. E. Olsen and Carl Mankel operated a gasoline shovel with a dipper of 1 cubic yard capacity, on the old mill site of Sierra Buttes Mining Company on North Yuba River at Sierra City. About 6000 cubic yards of gravel and tailing was worked in sluices.

BUTTE COUNTY

The year in Butte County has not brought in any large mines, although there has been an increase in prospecting and the installation of much earth-moving equipment such as drag-line scrapers and power shovels. When the demand for such equipment in road-building and other industries slackened, contractors became very active in searching for small areas of land which were reported to offer promise of yielding a profit by placer mining. This movement began in 1931 and has continued since. One of the larger installations of the high-line type was erected on the Feather River bluffs at Oroville to work gravel in the river and on a bar in the middle of the stream. A steel tower 95 ft. high was built to carry a 2-ton drag-line bucket. After six months operation in the latter half of 1932, the outfit lay idle until late in May, 1934. Drag-line dredgers such as the one mentioned under Yuba County have been put in operation near Wyandotte and Palermo by *Wyandotte Gold Dredging Company, Palermo Gold Dredging Company* and Butler & Crier; and one is being operated by Lawrence Neal near the Oroville-Marysville road. They handle about 1500 cu. yd. each daily. They use steam or power shovels for digging, these delivering gravel to revolving trommels on the barges which carry the gold-saving tables and belt conveyors for stacking. The cost per cubic yard with these outfits runs two to three times that for the larger regulation bucket-line dredgers, but because of the low first cost they can be put on small deposits that would not justify the larger installation. They are limited in application to loose, shallow ground and like the larger dredgers must have soft bedrock to permit good recovery.

Palermo Dredging Co. on Wyandotte Creek, 2½ miles east of Palermo.
Photo by J. D. Landes

Late in the year, *Yuba Consolidated Gold Fields* began work near Biggs preparatory to the installation of a dredger. Machinery from a boat which capsized near Fairplay, Colorado, and parts from one of the old dredgers near Hammonton are to be used. The company's options cover several miles along the east bank of Feather River between the Sutter-Butte canal and the Gridley bridge.

Large sums of money have been spent lately in searching for payable gravel in the lower end of the Magalia ridge, where the Mammoth channel is supposed to have entered the old inland sea. This channel has never been profitably worked and the work done recently (including a tunnel a mile long run by *Mammoth Magalia Mining Company* near Centerville) has failed to develop payable gravel, so far as known.

Several small drift mining prospects have been active late in the fall of 1934 near Bangor. The principal one is *Honcut Gold Mining Company, Ltd.*, a reorganization of Blue Lead Mining Company. The Gray Eagle channel was worked years ago on this property for a length of 1800 ft. At present they are working at a depth of 85 ft. on the Blue Lead Channel, where pay gravel is reported to be about 7 ft. thick on the south rim. From 400 ft. of 6 ft. by 7 ft. adit, good average returns have been obtained. This channel is 60 ft. wide here, but much wider on the Catskill Mine, the next property, and 2½ miles distant. When first opened the gravel is sufficiently cemented to require milling, which is done in a Krogh mill with a capacity of 20 tons an hour. Diesel engines of 80 and 40 h.p. are used to generate power and to compress air.

Other smaller drift prospects which showed activity late in the fall are: *Nieland Mine,* one-fourth mile southeast of Bangor, which has a vertical shaft 152 ft. deep and 130 ft. of prospect crosscuts in low-grade gravel; and the *Bootjack, Osgood* or *Channel Mine* which has an old shaft 80 or 90 ft. deep which was sunk to the channel bedrock years ago and was to be reopened. It also is near Bangor.

Little quartz mining is done in Butte County. The *Surcease Mine,* near Yankee Hill, has been a producer during the year, using a small ball-mill and cyanidation. *Hammond prospect,* about 5 miles from Berry Creek P. O. near the Merrimac road, was being equipped with a small mill late in the fall.

Berry Creek Mine, described in the last county report, and the *Galen Mine* near the Merrimac road 3 miles east of Berry Creek P. O., have both made some production since the last report. The latter has been opened by adits, of which the lower one, 246 ft. long, gives 150 ft. of backs on a vein 3 ft. wide. Both belong to Mr. and Mrs. Carl Johnson, Berry Creek.

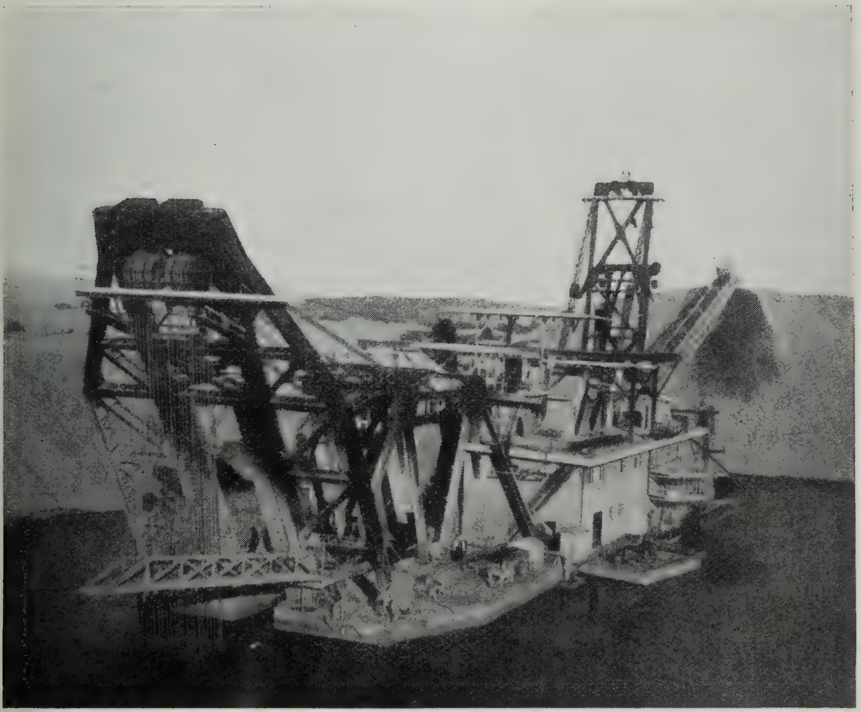
Gold Hill Mine near the Bald Rock road about a mile south of Berry Creek Mine in Sec. 34, T. 21 N., R. 5 E., produced over 300 tons of ore in 1934 from an open cut on a vein from a few inches to 22 inches wide. The water supply here is limited, and gives out in summer. There are an Amador rocker mill and a 7 by 9 in. rock breaker run by automobile engines. The shaft has an inclined depth of 165 ft. on a narrow vein which pinches down to a width of only 2 or 3 inches in places and has a very flat dip. The adit level, partly caved, is 350 ft. long and connects with the bottom of the shaft. Most of it is only a few feet below the surface.

Porter Mine in the Jordan Hill district, 7 miles north of Yankee Hill, has been prospected the past two years by *Madre de Oro Gold Mining Company, Limited.* Buildings and equipment, including a 5-stamp mill, rock-breaker, compressor and Diesel engine, have been put on this old mine, which had lain idle for over 50 years. Some milling has been reported.

William Gott and P. R. Peterson are working a recent discovery on the new Forest Service road 5 miles southeast of Hart's Mills. An 8-ft. arrastre operated by a gasoline engine crushes 1 ton of ore in 3½ hours.

YUBA COUNTY

The most important development in mining in this county in 1934 has been the launching by the *Yuba Consolidated Gold Fields,* in the Hammonton district, of the largest gold dredger ever built. The hull of the Yuba No. 13 was used. The new dredger has 126 buckets of 18 cu. ft. capacity each and is designed to dig 110 ft. below the water level, as compared with a depth of 83 to 84 ft. below water level reached by the Yuba No. 15 and other large ones of the company. The hull is 233¾ ft. long and the digging ladder 200 ft long with an idler on its under side to take up slack in the bucket line. The total length is 510 ft. and the weight 3220 tons. The bucket line uses a 650-h.p. motor and the total connected load is 1500 h.p.



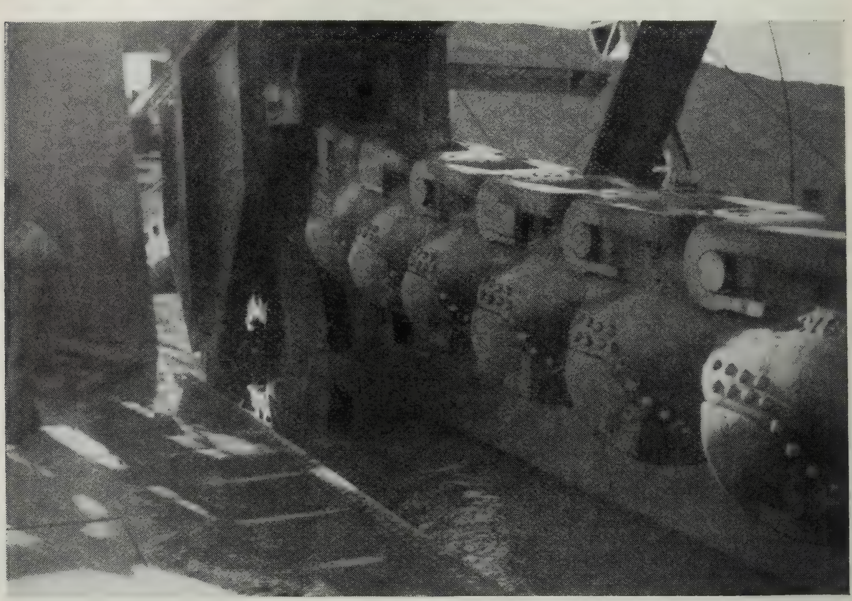
Yuba No. 17 Dredge, of Yuba Consolidated Gold Fields, near Hammonton, Yuba County.

Photo by Walter W. Bradley

This dredger was put in operation late in July on ground covered by tailings from the old No. 13 dredger.

The company remained one of the largest gold producers in the State in 1934, ranking third and keeping Yuba among the important gold-yielding counties.

Another interesting project is the reopening of the *Blue Point Mine* near Smartsville by *Gold Exploration Company,* a Utah corporation which has been working for 18 months. This old mine was first worked in 1854 and had a long history as a good producer. After hydraulic mining was enjoined it was worked by drifting until about 1894. Twenty years later, a stock company equipped the property with a 36-inch pipe-line, monitors, heavy electrc hoists for handling boulders, and a dry-land dredger with 7½-cu. ft. buckets. It was planned to pipe down the bank with monitors and then run the gravel through the dredger. A large slide from the bank is said to have hastened the end of this project. The present operators have sunk a 2-compartment inclined shaft 440 ft. long to bedrock ahead of the old workings, part of which have also been reclaimed. Twenty men have been employed recently and the erection of a mill to handle 150 tons of cemented gravel daily was planned in October.



Idler on return side of bucket-line, Yuba No. 17 dredge. This novel feature necessitated by extreme length of bucket line (200 feet) and weight of buckets—2½ tons each, or total 315 tons.

Photo by Walter W. Bradley

In April, a carload of ore was shipped to Selby Smelter from the *Doyle property* near Smartsville.

Near Strawberry Valley, J. M. Maynard reports finding good gravel at the *Lost Channel Mine* where he has been prospecting for some time.

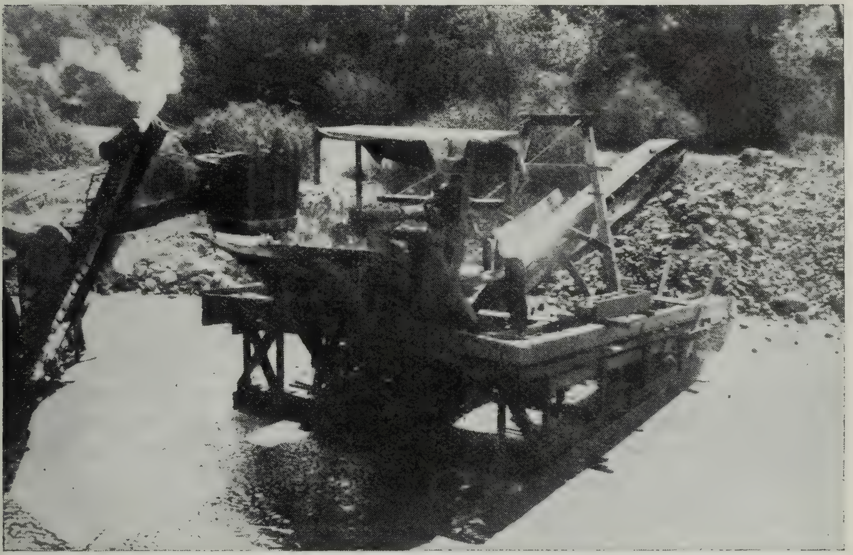
Pennsylvania Mine. During the year, a shallow shaft on the north end of this old mine at Browns Valley was deepened from 180 ft. to 484 ft. inclined depth. Cross-cuts were started both east and west on the 450-ft. level. No new ore had been found up to December, 1934, and late in January work was suspended, at least for the time being. The upper levels of this shaft produced some low-grade ore in 1906 and 1907, but farther south the Pennsylvania vein was a notable producer both in this mine and in the adjoining Jefferson. Previous to 1868, the Jefferson had been opened to an inclined depth of 612 ft. and had made a gross yield of $539,000 with dividends of $131,600. The old Pennsylvania workings finally reached an inclined depth of 1600 ft. but it has been idle for a long time.

The old *Race Track Placer Mine* at the mouth of Slate Creek which was partly fitted up for hydraulicking late in 1931, but not put in operation, may be worked by drag-line scraper next spring by Andrew Thickstun and associates.

In April, a drag-line outfit with a rated capacity of 2000 yards of gravel daily was put in operation on the *Gunning property* at the Narrows on Yuba River near the Nevada County line. A pit was excavated to float a scow which carries screens, gold-saving riffles and pumps. F. Payton is in charge. Gravel is dug and delivered by the drag-line to the scow where it is screened and the finer gravel and sand is pumped up to riffles for gold saving.

Wallberg Mining Company operated the *Horseshoe Mine,* a mile and a half northeast of Challenge, with the 10-stamp mill running part of the year.

H. G. Kumle in 1933 superintended building of a small dredger with 6 cu. ft. buckets on Dry Creek near Stanfield Hill, using parts from old dredgers hauled in from other fields. About 2000 yards of gravel, carrying some coarse boulders, is handled daily.



Steam shovel working gold gravels on Kirkman land on Dry Creek near Stanfield Hill, Yuba County.

Photo by Walter W. Bradley

For three years previous to October, 1933, Kumle worked in this section with a steam shovel, on the *Minnie A. Kirkman* land.

The *Red Cross Mine* property of 160 acres, a mile north of Dobbins, has been divided for operation, the Red Cross Mining Company continuing work at their former site, where they have used a 2-stamp mill and small cyanide plant intermittently for many years.

Imperial Gold Mining Company has erected a cyanide plant on another part of the property to work a low-grade deposit. Changes in this plant needed to make it suitable for proper work have delayed operation, and further checking of claims made for the deposit is going on.

NEVADA COUNTY

The operations of *Empire Star Mines Company, Limited*, and *Idaho Maryland Mines Company* at Grass Valley have kept this county in the lead as a gold producer. The gold mining 'boom' has been in full swing here for the past two years, but aside from the increased output of the two large companies named, there has not been a great addition to the gold yield as yet, though the future is promising.

The first bond election under the provisions of the placer mining district act passed by the last legislature was held July 5, 1934. It resulted in favor of a bond issue of $200,000 by the *Black Rock Placer Mining District* to defray cost of a debris dam. The principal hydraulic mines in the district are the Omega, near Washington, and the mines at and near Relief Hill. The former has been a producer during the past spring and summer. Further action looking to the sale of bonds and erection of the dam has been held in abeyance pending the decision of the Federal government which, in turn, will follow the report just finished by the California Debris Commission on the matter of federal financing of debris dams on the Yuba and other rivers in the mining region.

Another matter of importance to hydraulic miners is the suit of Pacific Gas and Electric Company in the superior court at Auburn asking for an injunction against Liberty Hill mine operators and owners. The company furnishes water for domestic use to a number of towns in Placer County from a ditch supplied by Bear River, and alleges damage to its business due to mud from the mine tailings. The same company on January 21 filed a suit for $500,000 damages naming as defendants every hydraulic mining operator and mine owner now or recently active in the district tributary to that part of Bear River. The causes for action are alleged damage to electric generating equipment and canals, and pollution of domestic water supplies.

Other permits for hydraulicking in Nevada County are in effect as follows:

You Bet Mining Company, Ogden C. Chase, president, 633 Roosevelt Building, Los Angeles. Some mining was done early in 1934 and late in the year preparations were made for another season's piping. Late in November a blast was fired in a tunnel run in the Red Dog section of the property to break down the bank previous to hydraulicking. This blast blew out through the tunnel portal, causing considerable damage to nearby buildings and pipe line. The property lies on both sides of the narrow ridge between Steep Hollow and Missouri Canyon, and a tunnel has been run between them. Mining has been resumed during the past month with one giant.

Remington Hill Placers, Incorporated, Limited, F. A. Crampton, Box 830, Nevada City. Work has been going on at Remington Hill under Crampton's management since 1932. The first clean-ups were made early in 1933. During that year considerable money was spent in preparing for mining but the season following did not afford much water. The results of the work done, however, led the company to continue operation, and the current season should give tangible results as the water supply promises to be good.

Remington Hill is about a mile north of Lowell Hill and is the northernmost but one of the group of mines located on remnants of the ancient channel extending to Dutch Flat. It lies at a bedrock elevation of 3869 ft. Drift mining as well as hydraulicking had been done here in the early 1870's, as the clay and volcanic ash overburden covering part of the deposit is quite deep. In January, 1934, drift mining was going on with a small crew. The quartz mining activities begun in this county during the past two years have been mostly the reopening of old mines or prospects, heretofore described in the division's reports. Lack of funds for the Sacramento office have prevented field work here during the past few years.

Ancho Mine, 2 miles southeast of Graniteville, has been operated at intervals since 1929. Late in 1933 an electric power line was completed to the mine. During the latter part of 1934, eleven men were employed in development work. Small tonnages of ore were milled yearly since 1929.

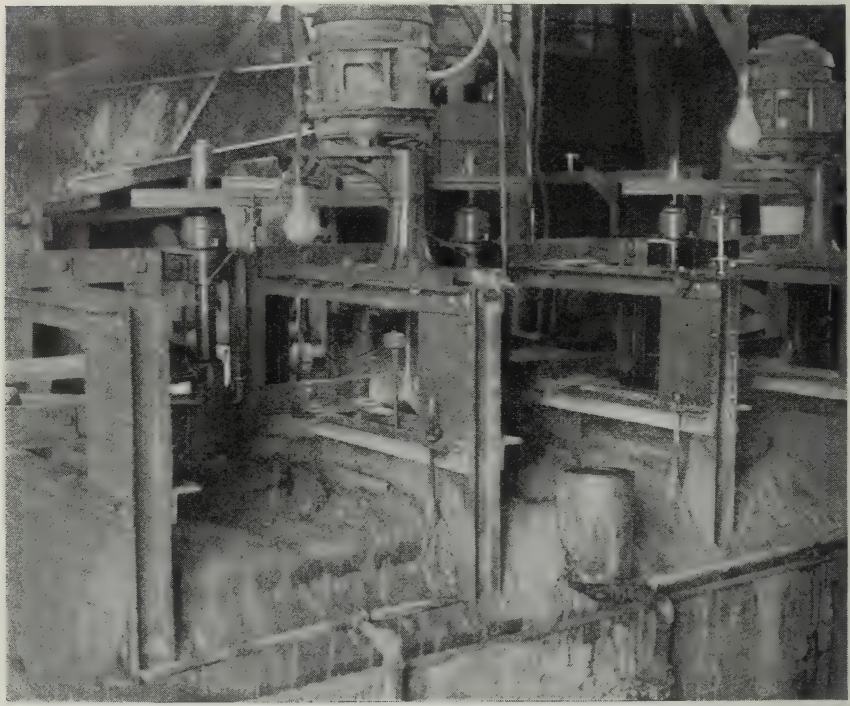
Black Bear Mine in the Rough and Ready district 5 miles west of Grass Valley, has been prospected since late in 1933 by the Cooley Butler interests represented locally by L. S. Wincipaw. Twelve men were employed late in 1934.

Brunswick Mine, 2 miles east of Grass Valley, has been the scene of great activity since September, 1933, when unwatering began. The Brunswick, having two shafts 1250 and 1347 ft. deep, respectively, is now controlled through stock ownership by Idaho-Maryland Consolidated Mines, Incorporated. The mine has been cleared of water and prospecting work started during 1934. The mill at the new Brunswick has been repaired and put in use for crushing ore from the Idaho-Maryland. Rehabilitation of the old Brunswick surface plant and shaft have also been going on. The Brunswick adjoins the Idaho-Maryland on the southeast and its workings will be ultimately connected with the latter, assisting materially in solving the operating problems that exist.

Bullion Consolidated Mine, on the State highway just south of Grass Valley, was unwatered in July, 1933, by *Grass Valley Bullion Mines, Incorporated,* a Nevada corporation. It had previously been opened to an inclined depth of 1500 ft. and 8 levels had been run. After unwatering, the property was equipped and a little work done underground, but small progress was made in the way of mining until August, 1934, when some ore from the 800- and 1500-ft. levels was hauled to a nearby mill. In November, 1934, Empire-Star Mines Company asked for an injunction against the Bullion operators, and for damages, claiming the latter had crossed underground into property belonging to the complainant.

Canada Hill Mine is one of several recently reopened by *West Mines Corporation,* which has just been superseded by *California-Sierra*

Gold Mines, Incorporated, under the same management. The three claims of this group lie about two miles southeast of Nevada City. Except for a limited amount of work in 1908-1910, it had been lying idle since 1887. The inclined shaft was about 1450 ft. long and some two miles of drifts had been run by former operators. The workings were cleared of water in September, 1933. Electric power was brought to the mine and an air compressor, electric hoist and other equipment was installed. Leases were granted to tributers to work remnants of ore left by the former operators. During 1934 the company did some work on the 19th level (about 500 ft. deep vertically) running along the Canada Hill vein toward the St. Louis vein, which in the old levels cuts across and faults the former. The Canada Hill or Charonatte vein was the productive one in the old workings, and has lately produced a small amount of ore which was crushed in 1934 at the company's Queen Lil mill.



Kraut Flotation Unit (4-cell) in mill of Empress Mine, near Grass Valley, Nevada County.

Photo by Walter W. Bradley

Other properties that have been recently reopened for prospecting by the same company are the *Hussey* and *Ragon,* both in the Nevada City district and previously opened to only shallow depths. The Hussey has made a small production during the year. The company has also operated the mill on the Queen Lil Mine, a mile from Nevada City beside the Downieville highway, as a custom mill. O. McCraney is in general charge as manager, assisted by Gordon Bettles.

Central Consolidated Mines, three miles southeast of Nevada City, and *Banner Mines,* one mile north of the latter, are being worked by *Lava Cap Gold Mining Corporation,* which see.

Columbia and *Ocean Star* groups, 2 to 2½ miles east of Washington, had some work done upon them during the summer.

Delhi Mine, on the south side of Middle Yuba River, 4 miles north of North Columbia, has had considerable work done upon it during 1934 in preparation for examination and sampling. This is another old mine which was a producer beginning in the middle 1880's and remaining active until 1915. The steep slope permitted mining through adits, of which the lowest, No. 4, is 83 ft. above the river and 900 ft. below the outcrop. Below that, a winze was sunk about 500 ft. but water was a heavy handicap.

Empress (Dull or *Newtown) Mine,* in the Newtown district 3 miles northwest of Grass Valley, has been in operation during the past 2½ years, during which time the shaft has been deepened from 440 to 1000 ft. Ore has been milled irregularly during that time, with several changes in the milling plant. Finally, late in October, 1934, a plant with a reported capacity of 300 tons a day, including a ball mill and flotation cells, was finished. The ore here differs from that at Grass Valley, as the gold is saved in the sulphides principally. With the old plant, the concentrate was reported to carry 10 to 13 oz. gold and 110 to 125 oz. silver per ton. From 270 tons of concentrate shipped in 1933, a net average return corresponding to such values was claimed. The name of the company working this mine is reported to have been changed from Empress Gold Mining Company, Limited, to *Republic Gold Mining Company,* but with E. C. Jacobs remaining as manager.

Eagle Bird Mine, 7 miles by road east of Washington, has been prospected during the year, with 12 men employed late in the summer. The shaft, formerly 800 ft. long on an incline of 65°, was reported to have been deepened past the 1100-ft. point late in July.

Empire-Star Mines continued to be the largest among the gold mines, with most of their output coming from the North Star and Empire mines, which produced 76,595 fine oz. of gold in 1933 from 201,566 tons of ore. At the beginning of 1934 they admitted having ore reserves of about 257,000 tons of grade nearly equal to that milled in 1933. During 1934, work was continuous and two dividends were declared. The discovery reported in 1933 in the deeper levels of the North Star was investigated further with encouraging results which appear to give promise for the future of the mine.

Murchie Mine near Nevada City is also an important producer operated by the same interests. In 1933 it produced nearly 80,000 tons of ore that carried an average of 0.415 oz. gold and 1.48 oz. silver. In 1934 a new ball mill increased milling capacity to about 250 tons a day. The workings were 1600 ft. deep early in 1934 and sinking and raising have been going on for a new shaft. The Murchie ore carries considerable pyrite, galena and sphalerite as well as free gold, and is treated by flotation, yielding a rich concentrate.

Golden Center Mine, with a plant in Grass Valley and workings beneath the town, has been active during the past two years. Late in

Oliver Filters in cyanide plant of Empire Mine's mill at Grass Valley, Nevada County.

Photo by Walter W. Bradley

1934, about 75 men were reported employed. This mine has an inclined shaft on an angle averaging 28° dip, 1160 ft. deep, with a winze below the 1100-ft. level. Prospecting has been going on at that level, as well as raising toward the 500-ft. level. The Golden Center has been a substantial producer during 1933 and 1934. It is the principal one of several under the control of Cooley Butler. L. S. Wincipaw is local manager.

Hoge Mine, which has been developed since 1930 on a prospect discovered upon the Harmony gravel mine property and adjoining land in the Willow Valley section, had reached a depth of 1200 ft. early in 1934. It became a producer in a small way almost from the surface. Several thousand tons of ore from it was crushed at the Murchie mill before a milling plant was put on the Hoge itself late in 1932. The ore was concentrated by flotation during the next two years in a mill which handled 50 to 60 tons a day. In August, 1934, all of the crew except a few men needed to keep the mine clear of water and open were laid off, pending a reported reorganization of *Great Northern Gold Mines, Incorporated.*

New steel head frame of Idaho-Maryland Mine, Grass Valley, Nevada County.

Photo by Walter W. Bradley

Idaho - Maryland Mine was the scene of many surface improvements and the mine was actively worked throughout the year, retaining its position next to the Empire-Star as a lode producer. New cyanide and flotation machinery was installed, as well as a 1000-ton ore bin and a Marcy mill of 300 tons capacity. A shaft called Idaho No. 2 is being sunk by a new method between the old main shaft and the Brunswick. The Newsom shaft-boring machine is being used in this work. It is operated by a 40-h.p. motor and cuts a circular core 5 ft. in diameter, using iron shot for cutting. Sections of core weighing as much as 10 tons have been removed from this shaft, which at the end of the year had reached a depth of about 200 ft. A headframe has been built and a 150-h.p. hoist installed here. The new shaft will provide a second exit and ventilation for the mines, connecting with a drift about 500 ft. deep. Much work has also been done at the Brunswick both above and below ground.

The Idaho-Maryland was the second largest producer among the quartz mines in the state also in 1933, producing that year 68,233 tons of ore containing $13.38 a ton gold and silver, with tailing averaging $0.701 a ton, both at the old price. The future of the property appears flattering in view of the fact that so far the mine has been opened only to a depth less than half that reached in the neighboring large mines. The new mine workings and surface plants will also remove the handicaps to operation that have existed ever since the new company began work through the roundabout workings left by the former operators. Errol MacBoyle is manager of both the Idaho-Maryland and Brunswick.

Mattie Gold Mining Company. This is a stock company based on the *Alcalde claims* in the Deadmans Flat section several miles southwest of Grass Valley. The present company is reported to have sunk a 3-compartment shaft on 70° incline to nearly 800 ft. inclined depth late in 1934. The Alcalde, formerly called the Kenosha or Seven-Thirty has produced a little 'high grade' at intervals since early days.

The same company claimed to have control of the *Normandy, California, South Star* and *Standard groups* of claims, all lying north of the Alcalde and with shallow workings, the deepest being the 600-ft. shaft on the California.

Spring Hill Mine. Active prospecting under the direction of H. R. Plate has been going on for over two years at this property, just north of the Idaho-Maryland. A shaft has been deepened to 900 ft. and several thousand feet of drifts, crosscuts and raises have been run, without any announcement as yet from the management regarding results. About 6000 ft. of diamond drilling has also been done. During 1934 the same interests began work reopening the adjoining *Golden Gate,* which has an old inclined shaft 1020 ft. deep (498 ft. vertically), 160 ft. of winzes, over 3300 ft. of drifts and 900 ft. of raises and crosscuts. This old mine was reported being unwatered through the Spring Hill workings, using a diamond drill to tap the water near the bottom of the shaft, then pumping through the Spring Hill shaft.

Lava Cap Gold Mining Corporation began work on the *Central Consolidated* early in 1932. This old mine is on the east slope of Banner Mountain 5.7 miles from Grass Valley and had lain idle since 1918, during which time all equipment except a hoist had been removed. The new company has equipped the mine with a complete plant, including hoist with 150-h.p. motor, compressor with 225-h.p. motor and a mill with a rated capacity of 300 tons a day. This uses rolls and a Marcy mill, followed by flotation. Concentrate is shipped to Selby smelter. This mill was put in operation January 1, 1934, and has been reported as handling 100 tons a day during the first half of the year, after which the output was increased.

The shaft at the Central was deepened to 1000 ft. and the Belshaw shaft on the old *Banner Mine* (also included in the Lava Cap holdings) about 5500 ft. north of the Central Consolidated shaft, was reopened. It is 850 ft. deep. The ground between the two shafts is covered partly with andesite and is to be prospected by a drift now being run between these shafts on the 800-ft. Banner level.

PLACER COUNTY

Prospecting has been active in all parts of the county during the past two years, from the valley to the summits of the Sierra Nevada. A number of small producers have been developed.

Quartz Mines

Alabama Mine. This old mine, which was reopened in 1932 by George Phillips and associates, had lain idle since the late 1880's. It is in the granodiorite about one mile east of Penryn and the surface is planted with a fruit orchard. The shaft was 300 ft. deep. The first lot of ore milled in 1932 gave encouraging results and the shaft was reopened to the 200-ft. level. A 10-stamp mill was also erected by the partners and considerable ore was crushed. Early in 1934, *Alabama-California Mining Company* took over the operation of the mine and late in the year were employing 20 men. Three Fagergren flotation cells have been added and lately the company has been milling 30 tons of ore daily. A reserve of ore is claimed to be already broken in the stopes above the 200-ft. level, which has been opened for a length of 500 ft. Ore is said to be yielding $8 to $12 a ton, with about 1% sulphides, and silver is reported in considerable quantity. William Anderson, general manager.

American Bar Quartz Mine, 2 miles southwest of Michigan Bluff was operated part of the past year by *Industrial Engineering and Equipment Company.* This company has milled over 1000 tons of ore and done some development work, but suspended operations late in the year. The deepest adit, called Level D, gives 280 ft. in depth on the dip and is over 800 ft. long.

Beauty Mine and adjoining claims at Canada Hill in the eastern part of the county in the mountains near Robertsons Flat was early in 1934 made the basis of a stock company called Beauty Mines Consolidated, Limited. There is a mill of 10 stamps here and the addition of flotation was planned, but the company is reported to have suspended all work late in summer.

Bouck property, about a mile west of Auburn, is reported being equipped with a plant early in 1935. Old workings have lately been cleaned out and sampled.

Chicago Mine, just north of the Alabama near Penryn, is another old mine in the granodiorite which was worked last in the 1880's. A former superintendent reported that the old workings reached a depth of 500 ft. with several levels and that the vein was worked for a length of 400 ft. and averaged 2 to 3 ft. wide in the upper levels. A company was formed several years ago but little was done until interests represented by A. N. Sweet formed the *Auburn-Chicago*

Mining Company and began active work late in 1933. Early in 1934 a surface plant was completed and an Amador Rocker mill was installed. Reclaiming and prospecting has been going on since. The ore that has been milled is reported to have yielded satisfactorily. Lately a small rod mill and flotation cells have been installed. About thirty men have been employed recently and work is being done on the 400-ft. level.

Dairy Farm Mine is one of those mines of the foothill copper belt which was first worked for the gold and silver in the gossan covering the copper ores. Sulphide containing about 3% copper and some gold was found at a depth of about 85 ft. Thereafter, and especially during the World War, it was worked as a copper mine and was opened to a depth of about 600 ft., producing at the rate of 350 tons of ore a day. Late in 1933, work began to reopen the property as a gold mine. It was equipped with a cyanide plant and ore is being mined by a three-fourths cu. yd. gas shovel. During 1934, about 120 tons of ore has been treated daily until late in the year when tonnage was increased about 50%. The mine is 8 miles northeast of Sheridan. Orrin P. Peterson is in charge for the company which is made up of parties in Duluth and New York.

Gold Dyke Mine. J. D. Leedy has been hauling good ore from this claim to a custom mill at Nevada City the last two summers. The claim is in the Canada Hill district and the first work was done in 1932, when a 2-compartment shaft was started. This is now about 90 ft. deep.

Lost Emigrant Mine, about 9 miles in an air-line south and west of Soda Springs, was equipped with a small mill early in 1934, but this could not be operated because of lack of water. During the past summer, a small cyanide plant was used to work the old dump of tailings which accumulated years ago. F. McN. Hamilton was in charge for Lost Emigrant Gold Mining Company.

St. Lawrence Mine in the Ophir district produced some ore during 1934 which was milled at a nearby custom plant.

Suckers Revenge (formerly called *American Eagle*) *Mine.* Thirteen men were reported employed here in May. This claim is in the canyon between Towle and the Pioneer Mine.

Tahoe Treasure Prospect. These showings are in the mountains a mile or more west of Chambers Lodge on Lake Tahoe, and are near Quail Lake. Sulphides, principally pyrite and some arsenopyrite, occur disseminated through ancient schist forming remnants of a roof pendant on top of the granodiorite forming the Sierra Nevada. The elevation is 7000 to 7250 ft. The relative positions of the mineralized schist and the underlying granodiorite were noted by the writer when he visited the prospect September 21, 1932. At that time an adit had been started at an elevation of about 7000 ft. (aneroid). About 12 ft. from the surface the granodiorite occupied one-half of the face. It is reported that considerable money has been spent in placing equipment, building a power line and prospecting this ground during 1934.

Victory Mine is on the former State highway about 6 miles east of Colfax. It attracted attention in 1932 when, after lying idle many years, it was 'rediscovered' by Phelps and Russel who began taking out ore at the surface which yielded over two ounces gold and 12 ounces silver per ton. Several lots of ore were taken out of a vien about 3 ft. wide in sinking a shaft 88 ft. deep. The grade of ore dropped at that depth and the work was abandoned. In the summer of 1934, H. E. Loufek, J. E. Johnson and associates began work and reopened an old adit run years ago, in which they have been sinking a winze. Late in the year four carloads of ore was reported to have been shipped. On account of the increased price of gold, this has yielded nearly as much return per ton as the earlier shipments. The ore, even at and near the surface, showed a high percentage of sulphide with no visible free gold even in specimens with a high gold content.

A number of other properties have been prospected.

Placer Mines

American Hill Placer is about 4 miles south by trail from Secret House. There is a placer deposit here reported to be about 1700 ft. long, 250 ft. wide and from 10 to 100 ft. deep, which was worked by drifting on bedrock until the late 1880's. Pendleton Brothers have been working here several years to bring water to the property for hydraulic mining, and should have it in operation soon.

American River Gold Mining Company has contracted to purchase 480 acres in Sec. 23, T. 13 N., R. 9 E., from Southern Pacific Land Company. This property is on the Middle Fork of American River 18 miles from Auburn, and is on the opposite side of the river from the Hines-Gilbert quartz mine. Placer mining equipment is now being installed.

Baker Divide Company has been running an adit during the year at their property near Baker Ranch.

Chenoweth Dredger. A small dredger, for which machinery was brought from one dismantled near Comanche, was completed and put in use east of Roseville in the Allens district on Strap Ravine about June 1st by F. Chenoweth. The ground is shallow, being in slightly rolling country mostly planted to fruit orchards and drained by small streams which become dry or nearly so in summer.

F. G. Fabian et al., reported to be operating under the name of *Enterprise Leasing Company,* sank a shaft at Dutch Flat late in 1933 to prospect gravel under the town. A good showing of gold is reported to have been found at a depth of 130 ft. and work continued in 1934.

Gold Hill Dredging Company. Preparations for building this dredger were started by Walter W. Johnson in June, 1934. It is on the old Laird property about 4 miles southeast of Loomis. Drift mining was carried on for many years in that vicinity and it is said with good results. What was probably one of the ancient courses of the American River, now marked only by a few small andesite-covered hills, traversed the country flowing southwest from the region just south of Auburn and emptying into the inland sea of the Ione period not more than 2 or 3 miles southwest of the site of the present work. The region has since been eroded and this section is the only remnant of any size remaining. The channel gravel lies on granodiorite bedrock. The O. L. Barton property nearby has also been under investigation.

Home Ticket Drift Mine is an old property at Last Chance which had lain idle for years when *Black Bear Consolidated Mining Company* began work on it in 1933 and produced a little gold that year. Some gravel remained in it which was too low-grade to pay under the old gold price and with high working costs. During the spring of 1934 production was increased, amounting, according to the company's statements, to about $2,700 in March and about $3,000 the next month.

Iowa Hill Gold Mining Company has been prospecting the *General Grant Placer* in Iowa Hill district during the past year.

Lost Camp Hydraulic Mine was prepared for work late in the fall of 1934. It is near Blue Canyon, on a remnant of a white quartz channel which outcrops without overburden but contains considerable volcanic ash and sand.

Paragon Mine, two miles northeast of Forest Hill at the old camp of Bath, has had a large sum expended upon it during the past two years in preparation for hydraulic mining. Old ditches were cleaned out and piping was started late in March, but had to be stopped in a short time as the water supply was insufficient. Further applications for water were filed during 1934 and work was continued in preparation for the present season. King C. Gillette and Thomas H. Rosenberger have been mentioned locally as largely interested in this project. The latter died late in 1934. In November, 1933, over 160 men were employed, mostly on the ditches and flumes, and several hundred thousand dollars expenditure has been involved, making it the most important mining undertaking of late years in the county.

Many *other placer mining* ventures concerning which few details have been learned because of lack of funds and time for field work, were started late in 1933 or during 1934. A particularly transitory type of operation is that carried on with drag-lines or gasoline or steam shovel outfits. These as a rule require only a small investment as they utilize contractors' idle equipment. Such rigs have been used recently at several places, notably near the old Franklin House, between Folsom and Auburn; on the Hector ranch and the M. Kelly place near Rattlesnake Bar. The work on the Kelly land consisted of digging gravel along the river with a gasoline shovel. On the Clark ranch, 4 miles north of Lincoln, C. N. Chittenden installed placer mining equipment and began mining in October. The rated capacity is 50 cubic yards an hour.

Besides the Paragon, already mentioned, permits for hydraulic mining in Placer County were in effect December 22, 1934, for the following properties:

Turkey Hill Mine. E. B. Schueller, Forest Hill. Property is near Michigan Bluff.

Big Chief Mine, at Big Oak Flat. F. W. Tillotson, Michigan Bluff P. O.

Dharma Mine, near Michigan Bluff. F. F. Wolff, Michigan Bluff.

Dixie Queen Mine, Duncan Canyon. L. A. Davidson, Forest Hill.

Small Hope and *Arthur Mines,* near Forest Hill. Bert Farrar, Forest Hill.

J. D. Stewart of Auburn and J. Huntington Clark of Sacramento have each been supervising prospecting work on buried channels in the Iowa Hill district during the year.

SACRAMENTO COUNTY

This county remains one of the leading gold producers solely because of the operations of *Natomas Company* and *Capital Dredging Company.* Both work in the section 15 to 18 miles east of Sacramento and some distance south of the present American River. The former company used 6 dredgers and the latter 3 during 1934. During the year, Natomas Company began building a new dredger with buckets of 16 cu. ft. capacity at a cost of about $400,000. The company is reported to have paid dividends of $1,100,000 during 1934, with 995,820 shares of stock outstanding in July. During the first 10 months of the year 50,000 fine oz. of gold was produced.

The life of the dredging operations has been extended by the increased price of gold which has stimulated prospecting and resulted in addition of more land to the field south of the river. It is interesting to note that the gold dredging industry (centered principally in Sacramento and Yuba counties, which have 15 of the larger of a total of 26 dredgers in operation in the State) employs about 700 men and in 1934 produced between 190,000 and 200,000 fine ounces of gold out of a total yield of 701,000 fine ounces for the entire State.

Other operations during the year in the county were:

Gold Hill Dredging Company. A dredger with 9 cu. ft. buckets, for which machinery was moved from Dayton, Nevada, was finished and put in operation in the spring of 1933 on the McDerby and Keefe land 2½ miles from Folsom near the State highway to Placerville.

Gray Wing Extension Mining Company. This stock company opened a drift mine in 1932 on the Broder ranch east of Folsom, and in 1933 produced payable gravel but lost the pay streak and shut down after a reported output of $44,548. Early in 1934, they did more drilling, but suspended operation again without further production. The work was done through a shaft about 98 ft. deep, from which prospecting was done in a fan-shaped area. Many heavy boulders were reported.

Several *surface placer* mining projects were started in the county in 1934. Between Fairoaks and Folsom on Mississippi Bar, three outfits were operated, using steam shovels and trucks. Larson Brothers, A. F. Giddings and Robert Schwab, all of Sacramento, each worked separate plants here, handling several hundred cubic yards of sand and gravel each daily.

An outfit was also operated on the Van Vlick Brothers property, a mile east of Michigan Bar, by W. S. Davis and J. A. Kimmel.

EL DORADO COUNTY

Alhambra Mine, Spanish Flat district. Some good-sized pockets were found here during the year by drifting only a few feet from an old shaft 90 ft. deep that had lain idle for many years.

Big Canyon (Oro Fino) Mine is an old mine worked by Alvinza Hayward in the 1890's. After drilling and considerable experimental work on the possible methods of treating the ore, the *Mountain Copper Company* began construction of buildings on the mine in April, 1934. In July, work was started on an earth-fill dam with a reported capacity of over 400 acre-feet of water in the canyon above the mine. The mine is south of Shingle Springs and west of the Mother Lode. The ore mined in the past was a diabase breccia carrying disseminated sulphide. The entry of such a strong company, which is having success in the cyanide treatment of low-grade sulphide ore in Shasta County, means a great deal for El Dorado County.

Home-made, two-man gold dredge on Cosumnes River near Nashville, El Dorado County. Cost $197. They were recovering $1.50 per day at this point.

Photo by Walter W. Bradley

Boulder Mine in the Rescue district, west of the Mother Lode, has been active in 1934.

Canyon Creek Dredger, which began work on Canyon Creek in April, 1933, has been running steadily except for interruptions due to increasing the length of the bucket-line, stacker, etc., late in 1934. Most of the ground dug is composed of old hydraulic tailing from the seam mines of Georgia Slide. Some two miles in length along the creek are under lease. This dredger is said to work about 50,000 cu. yd. a month, and to dig 26 ft. deep.

Confidence Mining Company worked for a short time on a placer deposit at Cock Robin Point, near Volcanoville.

Grand Victory Mine, 7 miles southeast of Placerville, was reopened during the year. It contains wide veins of low-grade which were worked many years ago to a depth of 500 ft.

Gamblin Mine, east of Aukum P. O., was actively worked, the shaft having been deepened to 500 ft. during 1934. Considerable ore is claimed to be developed, and some milling was done in a plant with a daily capacity of 45 tons.

Pyramid (Gold Reserve) Mine, about 4 miles northwest of Shingle Springs, has been the most important quartz producer off the Mother Lode in El Dorado County in 1934. After making a large investment in plant, and doing much experimental work, the company settled down to steady operation with a crew of about 40 men in 1933. Ore is crushed in a ball mill and treated by the Vandercook mercuric cyanide process, perfected by A. E. Vandercook, the manager at the mine. George W. Peltier et al. of Sacramento are stockholders.

SAN FRANCISCO FIELD DISTRICT

CURRENT MINING ACTIVITIES IN THE SAN FRANCISCO DISTRICT WITH SPECIAL REFERENCE TO GOLD

By C. McK. Laizure, District Mining Engineer

MADERA COUNTY

From 1880 to 1893 the area now comprising Madera County was a part of Fresno County and the gold output was credited to the latter county. For these 13 years the amount so credited was $1,350,000. From 1893 to and including 1933 Madera County has a recorded gold production of $1,481,713. There are no county figures prior to 1880 although gold has been mined here since the 50's. In recent years the annual output has been very small, averaging about $2,000, but in 1932 and 1933 production jumped over 400 per cent, as renewed interest in gold mining has developed here, as in other mining areas. Probably few if any 'large' gold mine will be opened up, but there are opportunities for developing a considerable number of properties in this county into profitable mines of 25 to 50 tons a day output if overhead costs are kept within bounds.

The largest granite quarries on the Pacific Coast are situated in Madera County and granite is the most valuable mineral product of the county.

Bully Boy Group, consists of two claims owned by C. S. McDonald, and three claims owned by E. L. Melchonian, located 6 miles beyond Hildreth in Sec. 19, T. 10 S., R. 22 E. The mine has been developed by 14 tunnels of varying length at different elevations on the steep side of the San Joaquin River canyon, making a total of approximately 1000 feet of workings. All milling in the past has been done by arrastres. A 300-pound sample from the dumps recently given a mill test is reported to have had a value of $60 a ton. McDonald and Melchonian are continuing development and planning installation of a new mill.

Enterprise Mine. This mine is situated in Sec. 12, T. 7 S., R. 20 E., 19 miles northeast of Raymond, the nearest post office and railroad station. It is included in a large area of patented land owned by L. E. Hill of Raymond. The most active period of operation was in the early 80's. It was recently taken under lease by P. H. Collins of Cleveland, Ohio, and operations were started May 18, 1934. S. L. Sampson, superintendent.

The mine is on Potter Ridge. Country rock consists of micaceous schist and granite. There are two veins known as the Donkey Luck and West veins which occur in a fault zone. The principal developed vein has an average width of 14 inches, maximum width, 24 inches. The strike is nearly N.-S. and it stands almost vertical. Length of pay shoots 35 to 75 feet. The mine has been opened up to a depth of 400 feet by two main levels. At present mining is by overhand stoping from a winze, but operations are still in a development stage.

The mine is equipped with a 40-h.p. gas engine hoist, 10″ x 10″ compressor and 10-stamp mill with plates. Tailings are impounded. The mine has been operating one shift only and the mill intermittently, with two men on top, four in the mine and one in the mill. Another shift is to be added soon.

Bibl: State Mineralogist's Reports XXIV, p. 326; XIV, pp. 542-543; XIII, p. 208; XII, p. 156.

Josephine Mine. This mine at Grub Gulch, upon which a 20-stamp mill was once operated but which had been idle for many years, was equipped with electric power and pumps during the past year. A short time after unwatering however, the pumps were drawn and all equipment removed. It was stated locally that the mine was found to be too small to meet the operator's requirements.

Bibl: State Mineralogist's Reports XVIII, p. 304; XIII, p. 209; X, pp. 202-203; VIII, p. 213-214.

Mud Springs Mine at O'Neals, has been leased to Robert Glasier of Los Angeles, but active operations have not been started as yet. It is equipped with a mill.

Bibl: State Mineralogist's Reports XXIV, p. 324; XIV, p. 548; XIII, p. 211; XII, p. 161.

Ragsdale Mine, consists of three claims which adjoin the Bully Boy Group. This property is being developed by Harry Baumgartner. Five men are employed.

Bibl: State Mineralogist's Report XIV, p. 549.

Riverside Mine. This mine is on the San Joaquin River about one mile below the Bully Boy and Ragsdale. There are two quartz and one placer claims in the group. Owned by T. G. Jordan of O'Neals and E. A. Patterson of San Francisco. It is equipped with a 15-ton Ellis mill. Three men are working.

Bibl: State Mineralogist's Report XXIV, p. 325.

Texas Flat Mine. This well known property owned by Wm. J. Krohn of Coarsegold, which was developed to the 1200-foot level and active until 1927, has been under lease and option during the past year, but was not reopened. Other parties are now negotiating for a lease and prospects are good that it may again become active.

Bibl: State Mineralogist's Reports XXIV, pp. 325-326; XVIII, pp. 304-305; XIV, p. 551; XIII, p. 213; XII, p. 164; VIII, p. 212.

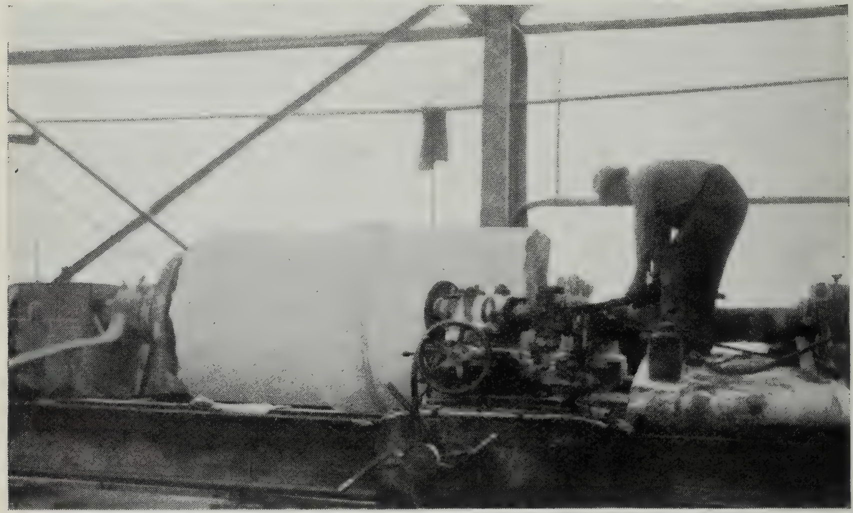
Waterloo Mine. This property consisting of six claims is situated about four miles southeast of Coarsegold in Sec. 15, T. 8 S., R. 21 E. It is now owned by J. E. Belden, Frank White, Wayne Harvey and Harold Mitchell who started operations in October, 1934. It was first worked by Mexicans in early days and was last active about 1901. Country rock is granite in which there is one main vein averaging four feet in width with a maximum width of six feet. The vein material is quartz with talc and schist, strike NE.-SW., dip 45° E. There are four known pay shoots which rake 45° N. About 60 per cent of the values are in free gold and 40 per cent in the sulphides.

The present operators are sinking a new shaft, down 14 feet at the time of visit, and erecting a new headframe. The mine is equipped with an El Dorado ball mill and if developments justify it, a cyanide plant will be added. Ten men are employed under the supervision of J. E. Belden.

Bibl: State Mineralogist's Reports XIV, pp. 552-553; XIII, p. 211; XII, p. 161; XI, p. 216.

PLACER

One of the two licensed gold buyers at Friant reports that he purchased small lots of gold from 150 different 'snipers' between January 1 and November 1, 1934. Most of this came from the gravel beds along the San Joaquin River in both Madera and Fresno counties.



Turning a section of a granite column at plant of Kingsland Granite Co. in Madera, Madera County.

Individual placer miners were also noted at work on the creek above Coarsegold, and at other points.

Ground below the old gravel pit at Friant (Fresno County) is being tested by a drilling crew stated locally to be acting for Natomas Company.

DIATOMITE

The deposit of soft smooth volcanic ash on the Armstrong Ranch in Sec. 1, T. 11 S., R. 20 E., two miles northwest of Friant, was taken over by Bennett and Jourdan of Selma, March 16, 1933. The material is mined from an open cut by steam shovel and trucks. It is partly sun dried, then finished in a dryer, screened and sacked. Operations are intermittent. When active, four to five men are employed.

Bibl: State Mineralogist's Reports XXIV, p. 345; XIV, p. 568.

GRANITE

Probably the most important recent development in the mineral industry of Madera County was the opening up of the Kingsland Granite Quarry in April, 1934.

The *Kingsland Granite Co.,* home office Fresno, California, controls 1100 acres covering an immense deposit of beautiful light-gray granite now being used in construction of the new Federal Building in San Francisco. The quarry is situated one-half mile from Bates Station in Sec. 4, T. 10 S., R. 20 E., and the finishing plant is on a railroad spur in Madera.

The stone is quarried by drilling, blasting and wedging, blocks weighing up to 35 tons, being taken by truck and trailer to Madera for finishing. The plant is of modern steel construction 400 feet long, with a 70-foot craneway and 300-foot by 60-foot leanto. Plant is equipped with a lathe capable of handling a column 30 feet long by 7 feet in diameter, 3 gang saws, 3 carborundum machines and 9 surfacing machines. Two compressors supply 1200 cu. ft. of air per minute for the machines.

Fifty men are employed at the quarry and 175 at the plant. Harry Johnson, superintendent.

MARIPOSA COUNTY

The San Francisco Field District comprises 22 counties most of which are in the central Coast and San Joaquin Valley areas. Included are six counties, Mariposa, Madera, Fresno, Merced, Stanislaus and Tulare, which lie on the western slope of the southern Sierra Nevada or along the border of San Joaquin Valley. Mariposa County is the most important gold producer among these six, and of the district as a whole.

Gold mining has been one of the chief industries of the county since the fifties but it had dwindled in later years, reaching a low in 1930 when the output of gold was only $58,985.

Since 1930 a very marked upturn in gold mining activities has occurred, as the following table of annual gold output of the county will show:

Year	Value
1930	$58,985
1931	88,600
1932	169,627
1933	254,663

The value up to 1932, inclusive, is figured at $20.67 per fine ounce. For 1933 it is figured at the average weighted price of $25.56 a fine ounce.

Figures are not at hand as yet for 1934, but activity has continued unabated. As a further indication of interest it is noted that 64 new mining location notices were filed in the county during the month of December, 1934, an average of more than 2 a day, and a total of 655 during the year. There is estimated now to be at least 50 producing mines large and small, and probably an equal number of properties being developed or under option with prospects of early development.

Due to the short time available, lateness of the season and heavy rains, the writer was unable to visit all active properties, but notes covering as many as possible are included in this summary.

B. and M. Mine. This property includes the Ramsden tract in Sec. 3, T. 6 S., R. 18 E. and the balance of Section 3 surrounding the Ramsden holding, acquired from the 'Fremont Grant' owners. The B. and M. holdings are in the Buckeye district on Buckeye Creek which runs through the center of Section 3. Both placer and quartz deposits are found here. It is owned by B. and M. Mining Syndicate, Inc., home office: 539 Roosevelt Building, Los Angeles. Operations, which began in 1933, are under the directions of E. J. Barrett and F. A. Mansfield. Work started on the placer area along the creek. This was equipped with a P. and H. power shovel and 1400-cu. yd. portable washing plant. Attention, however, soon was directed to the quartz veins on the property and operations were switched to their development. Two main parallel veins with feeders and possibly a cross-vein occur. The veins have an average width of 3 feet; maximum, 6 feet. Both foot and hanging-walls are granite. Their strike is NW.-SE., nearer E.-W., and dips are 45° S. and 68° S. respectively. No. 1 shaft is 110 feet deep with drifts of 50 feet and No. 2 is of the same depth with drifts of 185 feet. Lengths of pay-shoots not yet determined. Considerable high-grade ore has been encountered, some running up to $643 a ton, but the average mill-rock has run from $25 to $30 a ton. The ore is mainly free-milling, carrying only 3 per cent of sulphides. Gasoline and distillate are used for power.

Mill of B. and M. Mining Syndicate, Inc., Mariposa County.

The mill contains crusher, two 1250-lb. stamps, amalgamating plate and Wilfley table. Five more stamps were being added in November,

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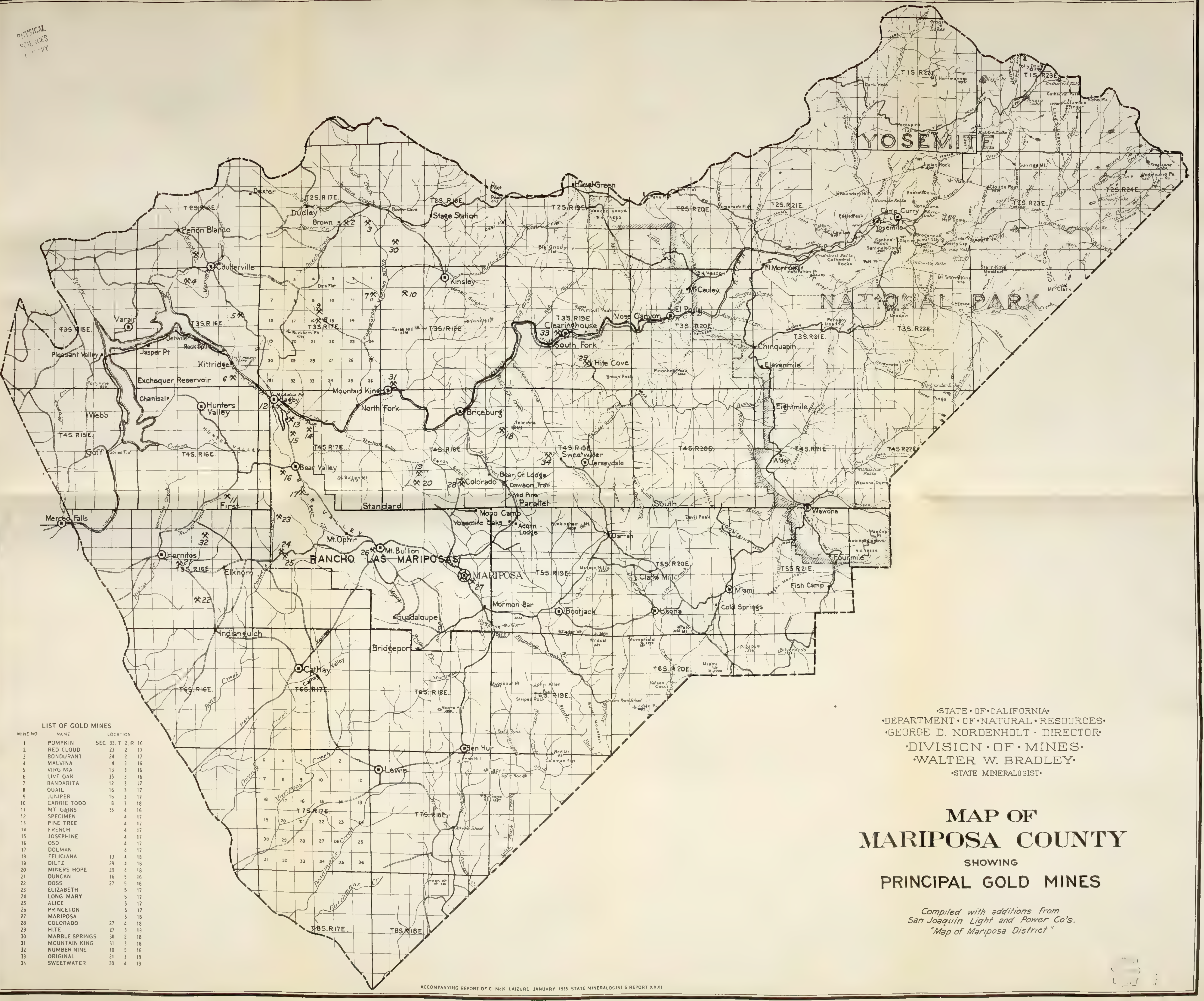

YOSEMITE
NATIONAL PARK
T1S.R22E.
T1S.R23E.
T2S.R16E.
T2S.R17E.
T2S.R18E.
T2S.R19E.
T2S.R20E.
T2S.R21E.
T2S.R23E.
T2S.R24E.
T3S.R15E.
T3S.R16E.
T3S.R17E.
T3S.R18E.
T3S.R19E.
T3S.R20E.
T3S.R21E.
T3S.R22E.
T4S.R15E.
T4S.R16E.
T4S.R17E.
T4S.R18E.
T4S.R19E.
T4S.R20E.
T4S.R21E.
T4S.R22E.
T5S.R16E.
T5S.R19E.
T5S.R20E.
T5S.R21E.
T6S.R16E.
T6S.R17E.
T6S.R18E.
T6S.R19E.
T6S.R20E.
T7S.R17E.
T7S.R18E.
T8S.R17E.
T8S.R18E.
Dexter
Dudley
Brown
Stage Station
Pilot Peak
Hazel Green
Peñon Blanco
Coulterville
Kinsley
Varain
Detwiler
Jasper Pt
Rock Spur
Pleasant Valley
Kittridge
Exchequer Reservoir
Chamisal
Hunters Valley
Bagby
Webb
Goff
Mountain King
North Fork
Briceburg
Clearinghouse
South Fork
Moss Canyon
El Portal
Mc Cauley
Hite Cove
Ft. Monroe
Camp Curry
Yosemite
Chinquapin
Elevenmile
Eightmile
Alder
Sweetwater
Jerseydale
Bear Valley
Bear Cr. Lodge
Colorado
Dawson Trail
Mid Pine
Parallel
South
Standard
Mono Camp
Yosemite Oaks
Acorn Lodge
Darrah
Wawona
Fourmile
Fish Camp
Merced Falls
First
Hornitos
Mt. Ophir
Mt. Bullion
RANCHO LAS MARIPOSAS
MARIPOSA
Elkhorn
Clarks Mill
Miami
Cold Springs
Usona
Bootjack
Mormon Bar
Guadalupe
Bridgeport
Indiangulch
Cathay
Cathay Valley
Ben Hur
Lewis
Buckingham Mt
Devil Peak
Mariposa Grove Big Trees
Silver Knob
Pilot Pk
Stumpfield Mt
Wildcat Mt
Striped Rock
Bald Rock
Red Mt
Coleman Flat
Buckeye Hill
Green Mt
Half Dome
North Dome
Basket Dome
Sentinel Dome
El Capitan
Cathedral Rocks
Indian Rock
Mt Watkins
Clouds Rest
Sunrise Mt
Vogelsang Pk.
Echo Pk.
Cathedral Peak
Columbia Finger
Mt Hoffmann
Dark Hole
Porcupine Flat
Grant Lakes
Mt Starr King
Mt Clark
Paragoy Meadow
Wawona Dome
Inspiration Pt
Bridalveil Falls
Glacier Pt
Buckhorn Pk.
Toser Hill
Pinoches Peak
Trumbull Peak
Big Meadow
Big Grizzly Flat
Merced Grove Big Trees
Bower Cave
Bullion Mt
Feliciana Mt
Mason Hill
Lookout Mt
John Allan
Moore Hill
Knob Hill
Spy Rock

LIST OF GOLD MINES

MINE NO	NAME	LOCATION		
1	PUMPKIN	SEC 33.	T 2.	R 16
2	RED CLOUD	23	2	17
3	BONDURANT	24	2	17
4	MALVINA	4	3	16
5	VIRGINIA	13	3	16
6	LIVE OAK	35	3	16
7	BANDARITA	12	3	17
8	QUAIL	16	3	17
9	JUNIPER	16	3	17
10	CARRIE TODD	8	3	18
11	MT GAINS	35	4	16
12	SPECIMEN		4	17
13	PINE TREE		4	17
14	FRENCH		4	17
15	JOSEPHINE		4	17
16	OSO		4	17
17	DOLMAN		4	17
18	FELICIANA	13	4	18
19	DILTZ	29	4	18
20	MINERS HOPE	29	4	18
21	DUNCAN	16	5	16
22	DOSS	27	5	16
23	ELIZABETH		5	17
24	LONG MARY		5	17
25	ALICE		5	17
26	PRINCETON		5	17
27	MARIPOSA		5	18
28	COLORADO	27	4	18
29	HITE	27	3	19
30	MARBLE SPRINGS	30	2	18
31	MOUNTAIN KING	31	3	18
32	NUMBER NINE	10	5	16
33	ORIGINAL	21	3	19
34	SWEETWATER	20	4	19

STATE · OF · CALIFORNIA
DEPARTMENT · OF · NATURAL · RESOURCES
GEORGE D. NORDENHOLT · DIRECTOR
DIVISION · OF · MINES
WALTER W. BRADLEY
STATE MINERALOGIST

MAP OF MARIPOSA COUNTY
SHOWING
PRINCIPAL GOLD MINES

Compiled with additions from San Joaquin Light and Power Co's. "Map of Mariposa District"

ACCOMPANYING REPORT OF C. McK. LAIZURE JANUARY 1935 STATE MINERALOGIST'S REPORT XXXI

1934, installation about 75 per cent completed. Seventeen men are employed, 12 on top at mine and mill and 5 underground. T. B. Fournier is acting superintendent.

Badger Mine (Prescott), in the Quartsburg district, has been worked during the past year by C. S. Shafer & Son of Hornitos.

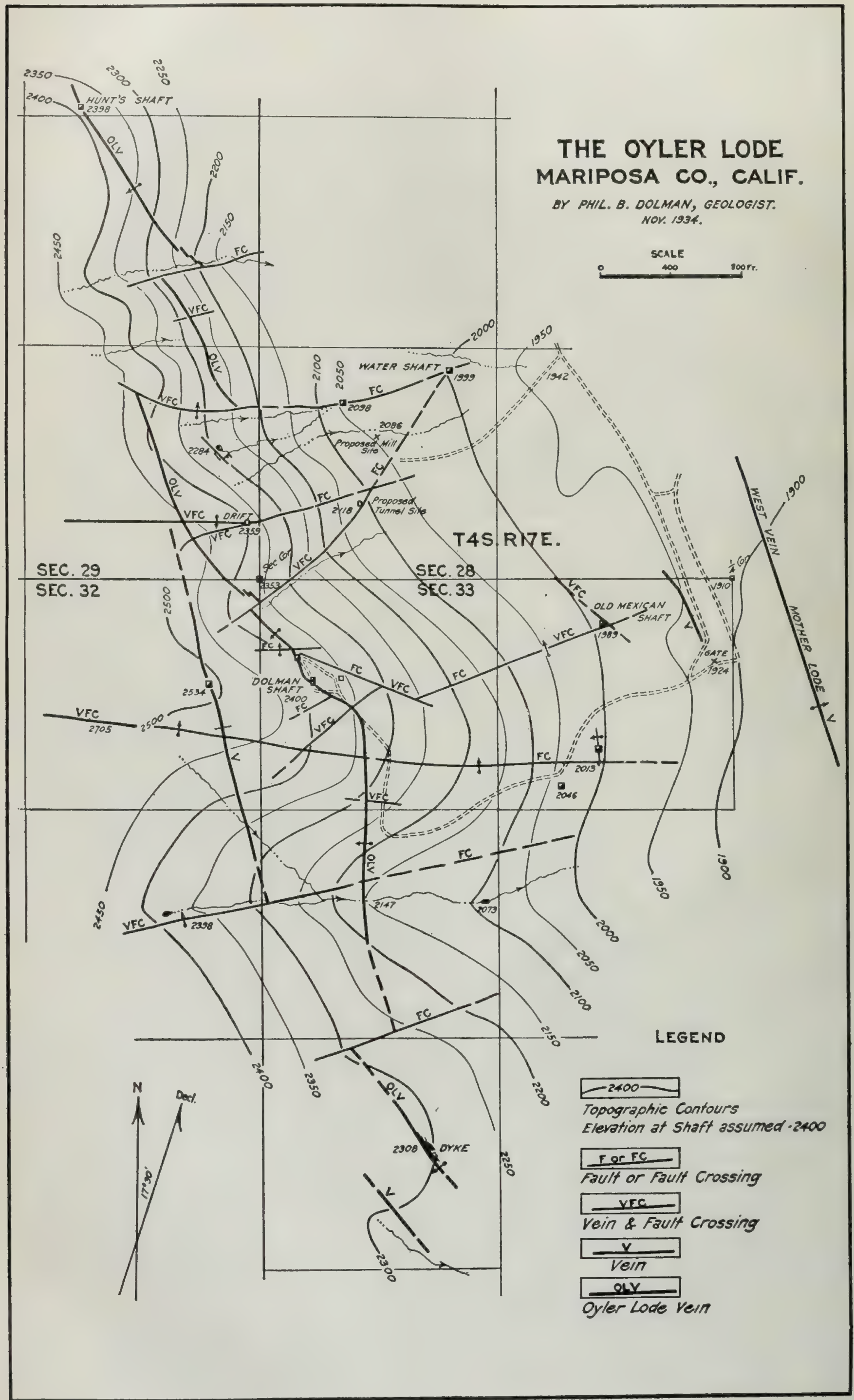
Barney Kane Prospect. One claim situated in the Darrah mining district at an elevation of 3200 feet. Owners: Mrs. Barney Kane, DeLux Auto Court, Merced, and Roy Green, Usona, California. Green sank a 35-foot vertical shaft in 1932 and ran an 18-foot drift which exposes a vein of free-milling gold ore about 4 feet wide, a sample of which assayed 1.31 ounces gold. The vein strikes NE.-SW. and dips 55° E. Country rock is granite.

Barrett Mine in the northwestern part of Hunter Valley is being operated by A. L. Gilbert, Oakdale, California.

Buffalo Mine is situated in the rugged area south of Midpines on the new road connecting Yosemite all-year highway with Jerseydale. Operations were started March 1, 1933, by *Gabriel Mining Company,* a copartnership. Address: Midpines, California. The property consists of one patented claim upon which mining is being carried on and eight unpatented claims. Country rock is granite, slate and porphyry. There is one main quartz vein varying in width from a few inches to seven feet, with feeders, all badly broken. Foot and hanging walls are porphyritic. The vein strikes N.-S. and dips 26° NE. It is proved on the surface for several thousand feet. The ore is free milling, but pay-shoots are short and irregular. There is only one level developed. Workings consist of 310-foot tunnel and winze reaching a depth of approximately 400 feet below the out-crop, with 500 feet driven on the vein and 1000 feet of upraises and intermediate drifts. One stope 100 feet by 150 feet. Power is furnished by Diesel and gas engines. The mine is equipped with a compressor and machine drills, a mill containing jaw crusher, five 1050-lb. stamps, plates and concentrating table. Tailings are impounded behind a dam in the creek. Monthly production has averaged $1000, total to date $10,000. Mill heads run $15 a ton and total operating costs are $6.50 a ton. Gold fineness 850. Two men are employed on top, four in the mine and one in the mill. H. R. Lawson is superintendent.

Diltz Mine. This mine was discovered by John Diltz in the 60's and the Diltz-Mann Lode claim was patented in 1872. The mine was closed down in 1895 at the time of Diltz' death, reopened in 1917, next worked in 1927–1928 and then abandoned. It was last reopened in 1931 by the present operators, Diltz Mines, a Trust Estate; H. C. Fowler, president; A. F. Grant, vice president; E. R. Baker, secretary. John W. Prout, Jr., is consulting engineer and geologist. During the past 3 years' operation it has drawn much attention to Mariposa County on account of the finding of several remarkably large masses of practically pure crystallized gold having values of from $7,000 to $10,500 each, at the old price.

The mine is in the Whitlock district in Sec. 29, T. 4 S., R. 18 E. about 6 miles in an airline northwest of Mariposa. It is reached from the State highway by 5 miles of fair county road. Elevation: 2900 feet, topography rough, with step hillsides. Water is obtained from


THE OYLER LODE
MARIPOSA CO., CALIF.
BY PHIL. B. DOLMAN, GEOLOGIST.
NOV. 1934.
SCALE
0
400
800 FT.
HUNT'S SHAFT
2398
WATER SHAFT
1999
2098
2086
Proposed Mill Site
DRIFT
2359
2284
2118
Proposed Tunnel Site
T4S. R17E.
SEC. 29
SEC. 32
SEC. 28
SEC. 33
Sec. Cor.
2353
OLD MEXICAN SHAFT
1989
1942
1910
¼ Cor.
GATE
1924
WEST VEIN
MOTHER LODE
DOLMAN SHAFT
2400
2534
2705
2013
2046
2147
2073
2398
2308
DYKE
OLV
VFC
FC
V
N
Decl.
17°30'
2350
2300
2250
2200
2150
2100
2050
2000
1950
1900
2400
2450
2500
LEGEND
2400
Topographic Contours
Elevation at Shaft assumed - 2400
F or FC
Fault or Fault Crossing
VFC
Vein & Fault Crossing
V
Vein
OLV
Oyler Lode Vein

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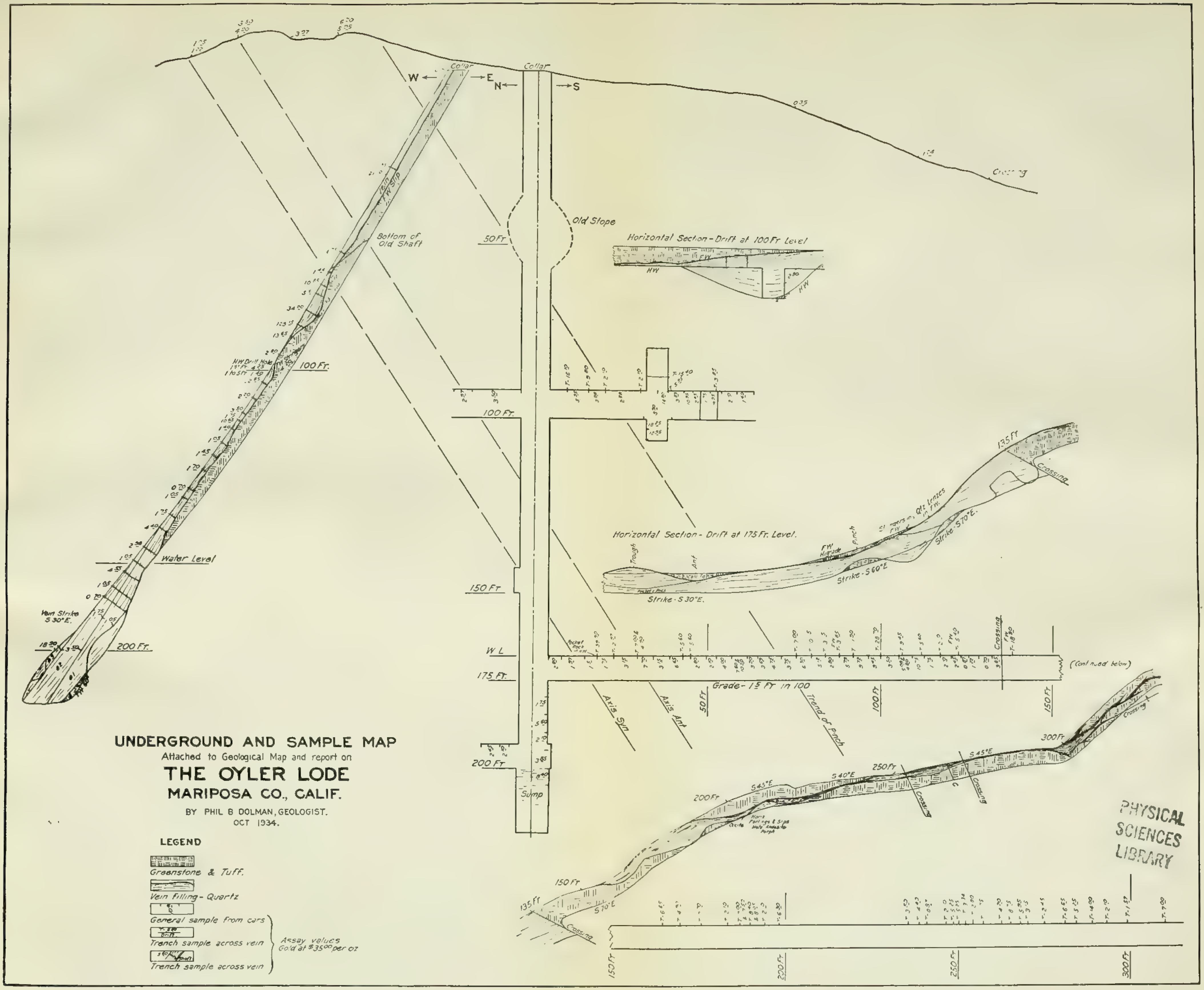

UNDERGROUND AND SAMPLE MAP

Attached to Geological Map and report on

THE OYLER LODE

MARIPOSA CO., CALIF.

BY PHIL B DOLMAN, GEOLOGIST.
OCT 1934.

LEGEND
Greenstone & Tuff.
Vein Filling - Quartz
General sample from cars
Trench sample across vein
Trench sample across vein
Assay values
Gold at $35⁰⁰ per oz
Collar
Collar
W
E
N
S
Vein
HW Slip
Bottom of Old Shaft
Old Stope
50 Ft
100 Ft.
100 Ft.
HW Drill Hole
Water Level
Vein Strike S 30°E.
200 Ft.
150 Ft
W L
175 Ft
200 Ft
Sump
Crossing
Horizontal Section - Drift at 100 Ft Level
HW
FW
Horizontal Section - Drift at 175 Ft. Level.
Trough
Ant
Pinch
Stringers in Qtz Lenzes in FW
Strike S 70°E.
Strike - S 60°E
Strike - S 30°E.
135 Ft
Crossing
(Continued below)
Grade - 1.5 Ft in 100
Axis Syn
Axis Ant
50 Ft
Trend of Pinch
100 Ft
150 Ft
S 45°E
S 40°E
S 45°E
200 Ft
250 Ft
300 Ft
150 Ft
135 Ft
S 70°E
Crossing
Crossing
Crossing
150 Ft
200 Ft
250 Ft
300 Ft

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2.

the mine, springs and in winter from Sherlock Creek. Besides the Diltz-Mann Lode, the W. Y. O. D. claim was located in 1910, the Sunset in 1925 and the Recorder in 1929, the total area being about 50 acres, which cover the lode for a length of 1600 feet. The country rock is andesite. There is one vein which has an average width of 4 to 5 feet, but reaching a maximum of 10 feet in places. The footwall is hard andesite (greenstone) and the hanging-wall blocky andesite, considerably altered and heavy. Strike is N. 10° E. and dip 37° E. It is proven on the surface for 1400 feet. Pay shoots average 350 feet in length. Greatest depth reached to date is 400 feet by tunnel to the vein which is then run 100 feet on the vein where it connects with an incline shaft that follows the orebody down. There is a total of 880 feet of drifting on the 4 levels; no crosscuts as yet. Electric power is used throughout, which is purchased from San Joaquin Light & Power Company at $0.075 per k.w.h.

Mine equipment consists of 12″x14″ compressor, 4 jackhammers, 2 stopers for 1″ hexagonal steel, 2″ mine pump, 1½″ sinker pump, hoist, blacksmith shop with oil furnace and drill sharpener, new boarding house and other camp buildings. The mill contains 15 1050-pound stamps, apron plates, 50-ton Gibson Amalgamator, Straub-Overstrom concentrating table and all accessories. Capacity, 50 tons per 24 hours. Tailings are impounded. From 25 to 35 men are employed. As of October 31, 1934, there were 2 men on top, 18 in the mine and 5 in the mill crew. Daily gross production for the first ten months of 1934 is given as $255.30; tonnage 32 (mill contained only 10 stamps prior to November, 1934); monthly production $7,659.05 from 762.8 tons; ten months of 1934, $76,590.51 from 7628.55 tons milled. Costs are stated to be: mining, $4.25; treatment, $2.25; estimated loss in treatment, $2.00; total operating cost $6.50 a ton; net operating profit $3.50 a ton.

Bibl: State Mineralogist's Reports XXIV, p. 85; XVII, p. 113; XIV, p. 581.

Dolman Mine, formerly the *Oyler Lode* on the 'Fremont Grant,' has been acquired by Hickman and Dolman, who have been developing it for the past year. R. L. Hickman, president; E. P. Hickman, secretary; home office, San Francisco. Phil. B. Dolman, superintendent, geologist and engineer, Bear Valley, California. The Dolman mine is in Secs. 29 and 33, T. 4 S., R. 17 E. on the flank of the ridge one mile west of the Mother Lode highway, and 1½ miles south of Bear Valley. Elevation 2400 feet. The total area included is 450 acres which cover 1½ miles of the lode. There is some scrub oak and jack pine; water is obtained from the mine.

The vein was discovered in 1894. In 1902 Oyler obtained a lease from the 'Grant' owners, put a shaft down 50 feet, and produced about 800 tons of ore which had an average value of $13 a ton, but the vein was thin and it was soon abandoned.

County rock is greenstone, in which the main Oyler quartz vein and numerous crossing veins with faults, and associated with a dike in the southern portion, occurs. Strike of the vein is N. 30° W., dip 60° E. The footwall is tough greenstone but the hanging wall is in places broken and oxidized.

Below water level the vein has a width of about 5 feet. Mineralization is localized in pay-shoots, there being one of 30 feet and several smaller parallel ones developed in the workings which consist of 220-foot incline shaft, 88 feet of drifts on 100-foot level and 250 feet on the 175-foot level, 15-foot raise and 6-foot winze on the 100-foot level. About 2000 tons of $10 ore has been proved up. Values run 40 per cent in free gold and 60 per cent nonfree. The mine is equipped with 180-cu. ft. compressor, hoist, jackhammer and Cornish pump, operated by gasoline engine.

Work to date has been development only, but the owners expect to install a mill and put it on production in the near future. A 60-h.p. Diesel engine is on the ground for future use.

Four men are employed on top, and three in the mine, including the superintendent.

Doss Mine (formerly *Ginaca Mine*). This property is in Sec. 28, T. 5 S., R. 16 E., 2 miles south of Hornitos. It was acquired by the Doss Mining Company, Matson Building, 215 Market Street, San Francisco, in October, 1933, and was operated until July, 1934, when it was closed down. The property consists of 2 claims and additional patented agricultural land. The surface is rolling. Water was obtained from a well on the Turner ranch.

The vein which averages 8 feet in width with a maximum width of 22 feet strikes N.-S. and dips 55° E. Both walls are slate. It has been proved on the surface for 1000 feet. Average length of pay shoots 250 feet. Workings consist of an incline shaft reaching a vertical depth of 220 feet, a 400-foot shaft, now closed, and an adit on the vein 540 feet in length. The ore is base carrying only $1 a ton in free gold.

The mine was equipped with a compressor and drills, 75-h.p. motor, and a 60-ton Hadsel Mill, 20 feet in diameter by 5 feet in width, driven by a 40-h.p. motor. The product from the Hadsel mill was cyanided in an all-slime plant with Merrill-Crowe precipitation system. Twenty-five men were employed when operating. Apparently all good ore was stoped out and milled as reserves are said to have a value of $4 a ton, too low to profitably mine and mill on the 60-ton a day basis.

Duncan Mine is in Secs. 16 and 21, T. 5 S., R. 16 E., about one mile southeast of Hornitos. This property had been idle for about a year when it was taken over and reopened by H. L. Berkey and associates, in October, 1934. Former operators equipped it with new buildings, electric hoist, etc., all in first-class shape. The shaft is down 325 feet on a 45° incline. Eight men are employed cleaning it out and getting ready for full operation. There are 3000 to 4000 tons of ore on the dump and reported to be the same amount developed in the mine. The values are spotty and some high-grade pockets have been taken out from time to time by lessees. No mill, except a small Huntington with which a man is running through dump material using a wheelbarrow to feed it. D. Onito, manager.

Bibl: State Mineralogist's Reports XXIV, p. 85; XX, p. 114.

Eureka Mine is located on Mt. Buckingham in T. 4 S., R. 19 E. It is being operated by Lovenguth and Metevedt, who started in the

Fall of 1933. Some very high-grade ore has been taken out here, one lot of 447 pounds assaying $10.00 a pound. The vein is 18 inches to 2 feet in width, with a rich streak in the center and the ore milled is reported to average $100.00 a ton. The mine is equipped with a small Lloyd cannon-ball mill, but shortage of water limits operations. There is about 900 feet of tunnel altogether.

Bibl: State Mineralogist's Report XXIV, p. 86.

Feliciana Mine, in Secs. 12 and 13, T. 4 S., R. 18 E., after several years activity was closed down late in 1934. It was last operated by *Gold Ledge Mining Co., Ltd.,* H. Z. Peters, general manager, 869 Russ Building, San Francisco. This company started a lower adit in June, 1933, to cut the vein at 900 feet depth. It had reached a length of 1186 feet in September, 1934, but shortly afterward all work was stopped. The mine is fully equipped with 35-ton mill, etc., which was operated by electric power.

Bibl: State Mineralogist's Reports XIV, p. 582; XVII, p. 115; XXIV, pp. 86-88.

French Mine is in Sec. 10, T. 4 S., R. 17 E. on the 'Fremont Grant.' It is one of the mines included in the holdings of *Pacific Mining Company* from whom Charles Sommers and 7 copartners sublease. Operations are on a cooperative basis under the direction of Charles Sommers. The lease covers 2000 feet of the French lode. Work began May 15, 1934. County rock is a diabase or greenstone. There are 2 quartz veins, the one being worked averages 20 inches in width and lies next to a porphry dike which forms the footwall. The strike is N. 70° E. and dip 30° S. It is developed by a 155-foot crosscut to the vein and drifts east and west 200 feet each way. The ore is free-milling.

The mine is equipped with compressor and air drills, cars and track and 5-stamp straight amalgamation mill, operated by electric power. Water is obtained from springs and pumped 300 feet to the mill. Gold content varies from $10 to $50 a ton, the average value of the mill heads being $20.

Golden Key Mine (formerly *Austin Group*). This property is situated in the Whitlock district, in Secs. 29, 30 and 32, T. 4 S., R. 18 E., about 6 miles northwest of Mariposa. It is within ½ mile of the famous Diltz Mine and adjoins the Spread Eagle (Miners Hope). The Whitlock Group is only a few hundred yards distant. Golden Key Mine was previously worked by the Austin Group Mining and Milling Company in 1912. The property was acquired by Golden Key Mining Company shortly afterward and it has been worked off and on for the past eleven years. Present operations were started in September, 1934. J. E. McDonald is manager. Home office: 1723 Webster Street, Oakland.

Holdings consist of 7 claims and 2 mill sites with water rights on Whitlock and Sherlock creeks. A new shaft has been put down 90 feet and it is the intention of the company to continue sinking this to 500 feet below the tunnel level. There is a gasoline hoist at the new shaft but electric power is used elsewhere. Work is being continued in both shaft and tunnel. About 600 tons of ore are now available which has a value of $17 to $18 a ton. The property is equipped with a 10-stamp mill, but it needs flotation equipment as the gold is mainly in the sulphides. Other equipment includes a compressor, fan-blower, new cookhouse and dining room, and assay office. Fourteen men are employed.

Bibl: State Mineralogist's Reports XXIV, pp. 79-80; XIV, p. 576. California Mining Journal, Auburn, Calif., October, 1934.

Hunter Valley Prospect. Geo. K. Allen and Harry McCreedy are sinking a shaft on a 6-inch vein of high-grade ore in Hunter Valley. Unnamed.

Iron Duke Mine. E. F. McTarnahan and associates started development of the Iron Duke, Commercial and Petro claims in Hunter Valley during July, 1934. These claims adjoin the well-known Oaks and Reece Mine. There are 2 E.-W. veins upon one of which there is a shaft 106 feet deep. The 'shaft' vein is 2½ feet wide and has been traced for 1000 feet on the surface. The ore which carries free gold is milled in a 5-stamp mill at Horitos. Some of it is high grade with gold plainly visible.

Jumper Mine. Two men are working at the Jumper Mine in Sec. 30, T. 4 S., R. 16 E., owned by C. H. Burt, Mt. Bullion, Calif.

Bibl: State Mineralogist's Report XXIV, p. 91.

Juniper and Patricia Mines. The Juniper group consists of 2 claims in Secs. 19 and 30, T. 4 S., R. 17 E., owned by Dr. Zither and associates of Merced. The Patricia group consists of 4 claims located in Sec. 19, T. 4 S., R. 17 E., owned by C. C. Schlageter of Mariposa. Both properties comprising 120 acres are now under lease to George L. Reed, address: Bear Valley, California, who reopened them June 9, 1934. These holdings are in the Quartzburg district about 2 miles northwest of Bear Valley on the Bear Valley-Hornitos road, and lie at an elevation of 2600 feet. The surface is rugged and sprasely timbered. Water is obtained from springs and wells.

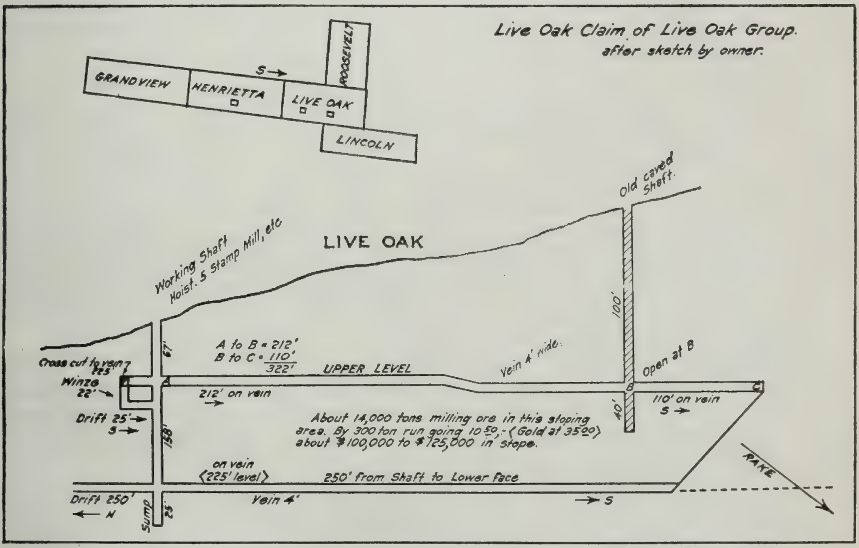
There is one main quartz vein in each property that ranges from 1 to 5 feet in width. The vein on the Juniper strikes N.-S. and that on the Patricia strikes NW.-SE. Both dip 45°. Country rock is schist and greenstone, which form the walls. The Juniper is opened up by an adit level 500 feet in length giving a vertical depth of 130 feet on the vein. There is an old shaft 320 feet deep (now closed) on the Patricia. A cross-cut adit is being run to this vein. Total workings on the Juniper 800 feet; on the Patricia 700 feet. The Patricia is equipped with gas engine, compressor, drills, track, cars, etc., and the Juniper with track, cars, hoist and blacksmith shop. Development work only is being done and there is no reduction equipment.

A total of 34 men are employed, 11 on top and 23 in the mine. Two blacksmith shops, 4 bunkhouses, a boarding house, office building, and several cabins have been erected in first-class manner, making an attractive camp. In addition 1½ miles of rock surfaced road has been constructed. Warren Dutton is superintendent; D. R. Jones, foreman.

Live Oak Mine (Stud Horse Flat Group). This property consists of five claims, the Live Oak, Henrietta, Grandview, Lincoln and Roosevelt; unpatented, and 2 mill sites. It is situated in Sec. 35, T. 35 S.,

R. 16 E., in Hunter Valley district, 3 miles from Hunter Valley, by road which is passable in winter and in good condition the balance of the year. Kittridge station on Yosemite Valley Railroad is 1½ miles from the camp by trail, and Bagby, the nearest post office, 3½ miles by trail. Owners are John P. and E. A. Carroll, Bagby, California. The claims lie at an elevation of 1500 feet on the gently sloping surface of Stud Horse Flat. There is plenty of oak and bull pine timber. Two good springs supply water for domestic use, but water for milling should be obtained from Merced River, distance 3200 feet, lift from river to mine 650 feet.

Country rock consists of slate, porphyry and diorite, porphyry on the footwall and diorite on the hanging-wall. Both walls are solid, no timber being necessary in the drifts. There is one main fissure vein with cross veins, consisting of banded or ribbon quartz and white quartz.


Live Oak Claim of Live Oak Group.
after sketch by owner.
GRANDVIEW
HENRIETTA
S →
ROOSEVELT
LIVE OAK
LINCOLN
LIVE OAK
Working Shaft
Hoist. 5 Stamp Mill, etc
Old caved Shaft.
100'
Vein 4' wide.
Open at B
A to B = 212'
B to C = 110'
322'
UPPER LEVEL
Cross cut to vein 225'
Winze 22'
A
B
C
67'
212' on vein →
110' on vein
S →
40'
Drift 25' →
S →
138'
About 14,000 tons milling ore in this stoping area. By 300 ton run going 10.50,-(Gold at 35.00) about $100,000 to $125,000 in stope.
on vein
(225' level)
250' from Shaft to Lower Face
Drift 250'
← N
Sump
25'
Vein 4'
→ S
RAKE

Values run about 75% in free gold and 25% in sulphides of high grade, $150 to $600 a ton. The vein has an average width of 4 to 5 feet, maximum width 10 feet. It strikes NW.-SE. and dips 76° W. It has been traced over one mile on the surface.

The mine was opened up by an old 80° incline shaft 140 feet deep, now caved, and a drift south on the 100 foot level in which the vein widened to 10 feet. Most of this work was done by the owners alone.

Since then a crosscut has been run 225 feet to the vein with a drift south 320 feet on the 68-foot level and a new working shaft sunk 250 feet with a 250-foot drift south and 250-foot drift north on the 225-foot level. The new shaft is a double compartment one in excellent condition. These and other workings are shown on the accompanying sketch. As indicated there is a stoping area between the two levels containing about 14,000 tons of $10.50 ore. Further drifting south on the 225-foot level would add considerable to available milling ore.

The mine is equipped with a 5-stamp mill (1000-lb. stamps), 225-ton ore bin, 10-in. by 12-in. Sullivan compressor, air receiver, 2 Deister concentrators (slimers), necessary electric motors and electric hoist good for 500 feet. Electricity is supplied by San Joaquin Light & Power Company. Five additional 1000-lb. stamps are on hand but not erected.

There is also a fully equipped assay office, blacksmith shop, and 8 buildings, including cookhouse, etc.

The company which put on the present equipment sunk the new shaft and drifted on the 225-foot level, was not sufficiently well financed to carry on and quit in 1932. The ore milled by them (300 tons) averaged $10.50 a ton at present gold price. Tailing below the mill run from $1.50 to $3.40 a ton.

Ore taken from the south end of the upper level between the old caved shaft and face of drift 20 years ago ran from $8.80 to $21 in an old 3-stamp mill. The longest run with this mill before it burned down, was 33 hours. From this run $300 was taken off the plates and 1100 pounds of concentrates gave smelter returns of $110 net after all expenses.

The mine is not under lease at present and is idle.

Bibl: State Mineralogist's Reports XIV, p. 598; XVII, p. 139; XXIV, p. 94.

Malone Mine is situated on the south side of Yosemite all-year highway near Yosemite Oaks resort. Owner: Thomas Gordon, Mariposa. Country rock is granite. There is a small vein upon which three men are sinking a shaft with a windlass. A 5-stamp mill, partly erected, is on the ground.

Malvina Mine (Melvina). This is one of the four principal productive mines formerly owned and operated by Merced Gold Mining Co. (now dissolved), whose holdings covered an area of 1000 acres near Coulterville, in Ts. 2 and 3 S., R. 16 E. The others were the Mary Harrison, Louise and Potosi mines.

In the latter part of 1933 a syndicate sponsored by Charles H. Segerstrom, who has long been identified with important mine operations, began unwatering the Malvina Mine for the purpose of sampling and reopening it, if conditions warranted. Electric power was installed, the first 200 feet of the large 3-compartment shaft was retimbered and by November, 1934, the 1010-foot shaft had been cleaned out to the bottom. The mine is equipped with a large steel-frame hoist-house and boiler room and Corliss steam flat-cable hoist, but the latter was changed to electric power. At the time of visit, unwatering was just being completed and 4 men were employed.

There is said to be 250,000 tons of ore available of a grade that could not be profitably worked during the 'steam-power' days but which may now prove profitable. It has since been reported that a crew of 9 men are engaged in sampling the 400-foot and 600-foot levels. Samples are of 50 lbs. each and are stated to be of higher grade than expected. If true, the Malvina will doubtless again be placed on the producing list and this may lead to the reopening of other mines of the group.

Bibl: State Mineralogist's Reports XXIV, p. 97; XVII, p. 123; XIV, p. 587; XIII, p. 220; XII, p. 172; X, p. 39; VIII, p. 347. Bull. 108, pp. 183-4.

Mariposa Commercial and Mining Co. This company is the owner of the famous Fremont Grant, Las Mariposas, an estate of some 44,500 acres (about 70 square miles) whose history has been outlined in an earlier report.[1] Further details are given by Logan,[2] recently.

Suffice to state here that the grant covers approximately 15 miles of the southern end of the renowned 'Mother Lode' and that more than 100 separate veins have been opened up on it since mining began in the fifties. A number of these were large producers in early days.

F. T. Maguire, resident engineer, with headquarters in Mariposa, reports considerable activity at the mines on the 'Grant' during 1934. These activities are summarized below. The more important operations will be further described under their individual names.

Pacific Mining Company acquired all of the north end of the 'Grant' extending from Merced River south to Sections 15, 16, and 17, including the Pine Tree and Josephine and other mines. They began extensive sampling and development work in July, 1931. The following July milling started, and at present (October, 1934) they are mining and milling from 100 to 120 tons per day. Fifty-one men are employed.

At the French Mine, which is sub-leased from Pacific Mining Company, a 5-stamp mill is in continuous operation. Eight men are working this mine as a cooperative enterprise.

On Bear Valley Mountain, Dolman and Hickman have been developing the Dolman (Oyler Lode) for the past year. Approximately $10,000 has been spent on development work to date. Seven men employed.

South of the Dolman about 1 mile, J. P. Frey, of Modesto, is developing a ledge. This appears to be on a contact of greenstone and slate. Ore from a shaft 50 feet deep has averaged $\frac{3}{4}$ oz. gold per ton. The vein is 3 feet wide. Equipment includes a 5-ton Ellis mill which is used in testing the ore while sinking. Three men are employed.

Tentative options have been given on the Elizabeth, Long Mary, a former producer, and Alice mines, to Frank Merrilees who expects to take them over.

The Mt. Ophir is being studied by George R. Barnett, of San Francisco, with a view of taking an option on it.

At the Ortega a 5-stamp mill is almost completed. This mine was last operated in 1856 at which time a 4-stamp mill was in use. The vein here is from 12 inches to 4 feet in width and is on the granite contact. It is opened up by a shaft 220 feet deep. In June some ore was milled which carried 2 oz. gold per ton. Seven men are employed.

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[1] State Mineralogist's Report XXIV, 1928, pp. 97-99.

[2] Logan, C. A., Mother Lode Gold Belt of California; State Division of Mines; Bull. 108, pp. 180, 186–189, 1934.

San Francisco and Oakland parties have sampled the Mariposa Extension (Rovnianik) but no decision has been made as yet.

Several lessees are at work in the Guadaloupe district. J. M. Handley has a shaft down 50 feet, showing fair values but no ore has been milled.

Bradford and Lyons have done considerable work on the Gilmore vein in the Buckeye district. This vein is about five feet in width and is on a slate and granite contact; strike NE.-SW. Values average one-eighth ounce gold per ton.

Barrett and Mansfield are mining and milling good ore at the B. & M. Mine. Five stamps are being added to the mill.

The Mariposa Mine has been taken over by Geo. T. Williams of San Francisco, but is idle at present. A shaft was sunk 140 feet on Stockton Creek which made about 50 gallons of water per minute, which was more than the pump installed could handle. Equipment includes an electric hoist and 400-cu. ft. compressor, all in first-class shape.

Mont Farley of San Jose is reopening the Ives and Daniel vein in the French Camp mine. Farley and his four sons make up the crew of five men. A shoot 100 feet long and 12 inches wide yielded one ounce gold per ton.

Kane Bros. are operating the Morman Bar near Mariposa, which is equipped with a small mill. They are negotiating for additional ground.

Approximately 150 men altogether are now employed at the 'Grant' mines.

The company has not objected to small-scale placer mining by individuals (sniping) on their property during the depression, and there are several small colonies of workers on various creeks.

During the past few years, the company has adopted a liberal policy in the leasing and sale of their mines, and anyone with sufficient operating capital will be given every opportunity to take over any of them. The Princeton mine, the most famous of all the 'Grant' mines, is not being operated and the company would particularly like to see this one reopened.

Bibl (in part): State Mineralogist's Report XXIV, pp. 97-99. Bull. 108, pp. 180-183.

Miners Hope (Spread Eagle) Mine. This property is in the Whitlock district, 6 miles by road north of Mariposa, in Secs. 29 and 32, T. 4 S., R. 18 E. *Whitlock Mines Corporation*, Martin Tresider, manager, reopened the mine in the spring of 1934 and in October the 5-stamp mill was being operated. A gasoline engine furnishes the power. Ten men are employed.

Bibl: State Mineralogist's Reports XXIV, p. 17; XVII, p. 126; XIV, p. 597.

Morman Bar Mine is in SE$\frac{1}{4}$ of Sec. 25, T. 5 S., R. 18 E., originally a part of the 'Fremont Grant.' The mine was discovered over forty years ago and is owned by H. H. Lovenguth of Morman Bar. In March, 1932, G. C. and L. J. Kane, brothers, an experienced 'hard-rock' miner and expert millman, respectively, took it under lease and option.

The mine is located two miles southeast of Mariposa at an elevation of 1800 feet and is easily reached by good road. A total of 35 acres comprise the holdings.

The deposit consists of a white quartz vein varying in width from a few inches to a maximum of four feet in decomposed granite. It is accompanied by a diorite dike with many displacements. The general strike is E.-W. with flat dip north at the surface. The ore carries fine free gold rarely visible to the naked eye, with no sulphides. The greatest depth reached is 120 feet on an incline of 30°. There are 200 feet of lateral workings on the 80-foot level, two underhand stopes and an upraise, exposing pay ore on several faces. Drilling is done by hand or auger drills. A 12-h.p. Novo gasoline hoist handles a car on rails in the incline and it is then trammed to the mill ore bin. The mill contains a jaw crusher, Straub rib-cone mill of 9 to 12 tons capacity and amalgamating plates. Water is obtained from a spring. Most of the gold is caught on special plates placed under the mill discharge screen. All ore taken out has been milled, its average value being $10 a ton. Production to date by the present owners has been 100 tons. The gold in this vein is very high grade, having a fineness of 951.75 and selling for $33.25 an ounce. The two owners work alone.

Morning Star Mine, a patented property in Secs. 11 and 12, T. 4 S., R. 16 E., owned by J. J. Trabucco of Mariposa, is being developed by J. H. Kelm of Bagby.

Orange Blossom Mine, is a pocket mine consisting of one claim in the Quartzburg district, owned by C. B. Cavanaro of Hornitos. It is being operated by H. A. McKenzie of Hornitos, who has taken out two $4,000 pockets during the past year. Production for the past two years has been in the neighborhood of $18,000. It is equipped with a 10-ton Lloyd ball mill.

Mt. Gains Mine. This is one of the largest mines in the Hornitos district, having a shaft 1350 feet deep with 11 levels and being equipped with a 20-stamp mill. It had been idle since 1910 until taken under lease in May, 1934, by *International Mining and Milling Co.,* Los Angeles (183 N. Martel St., Hollywood). Since taken over, 10 stamps and accessories in the mill were put in first-class shape and a little dump ore milled. Approximately $20,000 had been spent in rehabilitating the property up to October, but work was being held back pending the outcome of the November election. There is said to be large ore reserves in the old workings and two parallel veins in the footwall and one in the hanging wall that have never been developed. Like most of the mines in the vicinity of Hornitos the veins here are quite flat, dipping 30° to 35°. The ore is a heavy sulphide running 20 per cent to 40 per cent concentrates. Nelson Wagner is superintendent.

Bibl: State Mineralogist's Reports XIV, p. 589; XVII, p. 128; XXIV, pp. 103-104.

Original Mine. The Original Mine was last operated by the *Clearinghouse Mining Association,* a cooperative organization of the crew and J. W. Warford, former mine superintendent. They began exploring the south end of the mine on the 400-ft. level which the former company decided was not worth development and which had become inaccessible during the course of time. From January, 1933, to October 1, 1934, the Clearinghouse Mining Association made a gross production of $28,513 and paid two dividends of $8,839.05 and $6,565 and have $600 on hand, beside meeting royalty payments. The mine has been idle since October 1, 1934.

Bibl: State Mineralogist's Reports XXIV, pp. 107-109; XVII, pp. 131-132; XIV, p. 593. Engineering and Mining Journal, January 12, 1929, p. 45.

Oro Rico Mine (Penon Blanco). Unwatering of the Oro Rico Mine, 3 miles north of Coulterville, was begun late in 1934 by J. C. Kempvanee, Sr., and associates. Several men are employed.

Bibl: State Mineralogist's Reports XIV, p. 593; XVII, p. 132; XXIV, p. 109; XIII, p. 221; X, p. 43.

Pacific Mining Co. (See Pine Tree and Josephine Mines.)

Permit Mine (Kockel) (Bulldog) consists of one claim in Sec. 31, T. 4 S., R. 18 E., in the Whitlock district. It was acquired in March, 1932, by Permit Mines, Inc., Box 60, Mariposa, whose directors are A. J. Walters, J. J. Fahnlender, Mabel R. Brocke and Theresa J. Thompson.

There are three veins, the West vein 3 to 4 feet wide, the Center vein 2 feet wide and the East vein, 2 feet wide. Development work consists of 70-foot shaft on the West vein, 70-foot shaft and 500 feet of drift on the Center, and 74-foot shaft on the East vein. The ore carries from $15 to $20 a ton. Equipment consists of gas engine hoist, compressor and jack-head pump. No mill.

Bibl: State Mineralogist's Reports XIV, p. 578; XVII, p. 109; XXIV, p. 110.

Pine Tree and Josephine Mines. These two well-known 'Mother Lode' mines on the 'Mariposa Grant' and several smaller ones are included in a large acreage of the 'Grant' acquired in 1931 by Pacific Mining Co., A. V. Udell, president; C. A. Morris, secretary; home office 1022 Crocker Bldg., San Francisco; W. K. Cordes, mine superintendent, Bear Valley, Calif. The company's holdings comprise all of the north end of the 'Grant' extending from the north line of Sections 15, 16 and 17 north to Merced River at Bagby.

Both mines which are usually worked as one, were large producers from the early 50's to 1870. They were active again from 1900 to 1915 during which period $371,748 was recovered from 20,968 tons, an average of $12.40 a ton.

The present owners began an extensive sampling and development program in July, 1931. Six months was required for sampling alone. A pilot mill was then built and the following July (1932) milling started. At present (October, 1934) although operations are still in the nature of 'development work,' the company is mining and milling from 100 to 120 tons per day. It is planned to install a secondary crusher to reduce the ball mill feed to $\frac{3}{4}$ inch, and thus increase the mill capacity to 150 tons daily. Fifty-one men are employed, 7 on top, 35 in the mine and 9 in the mill.

PHYSICAL
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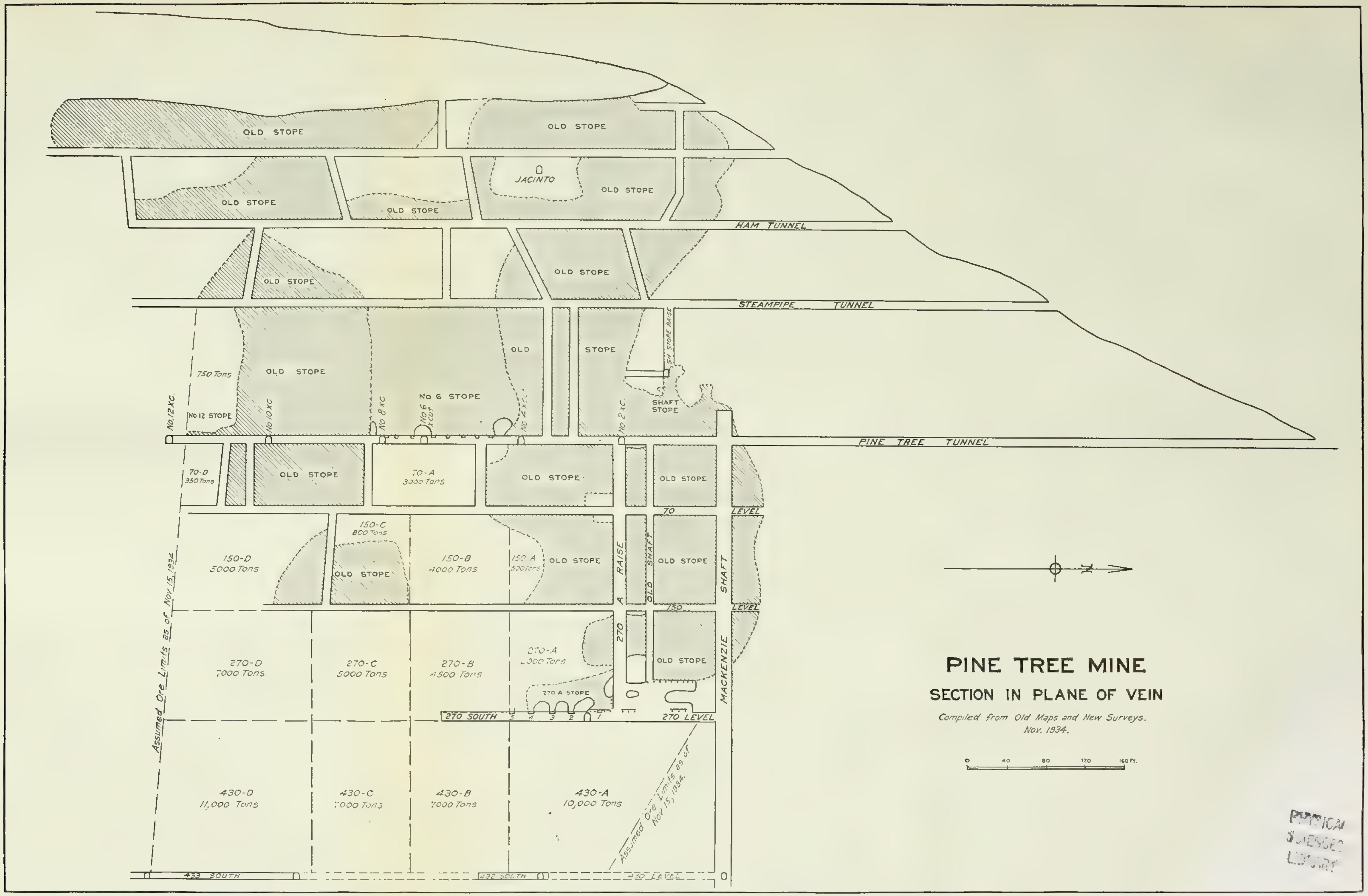
OLD STOPE
OLD STOPE
OLD STOPE
OLD STOPE
JACINTO
OLD STOPE
HAM TUNNEL
OLD STOPE
OLD STOPE
STEAMPIPE TUNNEL
750 Tons
OLD STOPE
OLD
STOPE
5th STOPE RAISE
No 12 STOPE
No. 12 XC.
No 10 XC
No 8 XC
No 6 STOPE
No 6 XCUT
No 2 XC
No 2 XC.
SHAFT STOPE
PINE TREE TUNNEL
70-D
350 Tons
OLD STOPE
70-A
3000 Tons
OLD STOPE
OLD STOPE
70
LEVEL
150-C
800 Tons
150-D
5000 Tons
OLD STOPE
150-B
4000 Tons
150 A
500 Tons
OLD STOPE
270 A RAISE
OLD SHAFT
OLD STOPE
MACKENZIE SHAFT
150
LEVEL
270-D
7000 Tons
270-C
5000 Tons
270-B
4500 Tons
270-A
3000 Tons
OLD STOPE
270 A STOPE
270 SOUTH
5 4 3 2 1
270 LEVEL
Assumed Ore Limits as of Nov. 15, 1934
430-D
11,000 Tons
430-C
7000 Tons
430-B
7000 Tons
430-A
10,000 Tons
Assumed Ore Limits as of Nov. 15, 1934.
433 SOUTH
432 SOUTH
430 LEVEL
N
0
40
80
120
160 Ft.

PINE TREE MINE

SECTION IN PLANE OF VEIN

Compiled from Old Maps and New Surveys.
Nov. 1934.

PHYSICAL
SCIENCES
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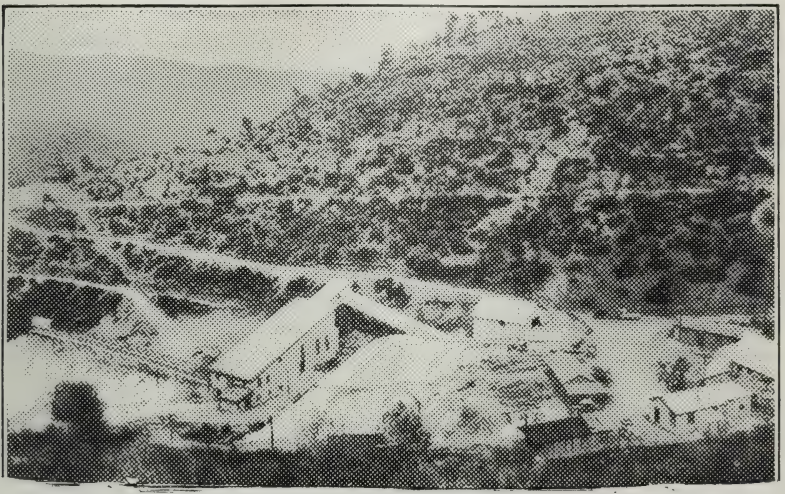
Extension of the old Pine Tree tunnel and of the 430-foot level south from the McKenzie shaft has blocked out a large tonnage of low-grade ore, and much additional ore can be developed by sinking or driving in at a still lower level. (See sketch of Pine Tree workings.)



Pacific Mining Company's Pine Tree and Josephine Mill, Mariposa County.
Cut by courtesy of Mariposa Gazette

The Pine Tree vein is on the hanging wall side (east). The filling is mainly quartz varying from 10 to 40 feet in width. Over an average width of 8 feet on this vein the ore has averaged 0.21 oz. gold per ton. The entire mineralized zone is 140 feet wide by 3000 feet long. The Josephine vein is on the footwall (west side) and consists mainly of quartz in slate. Between these two veins there is a complex formation, largely mariposite and schist, called the inter-vein. Over a 105-foot width representing an orebody, 800 feet long, the average value was .0845 oz. gold, and 80 feet in width gave an average of .17 oz. gold per ton.

The mine is equipped with a double-drum hoist of 50 horsepower and I-R 600-cu. ft. and Chicago-Pneumatic 300-cu. ft. compressors. Electric power from San Joaquin Light and Power Co.'s lines is used throughout, 200 horsepower in the mine and 175 in the mill.

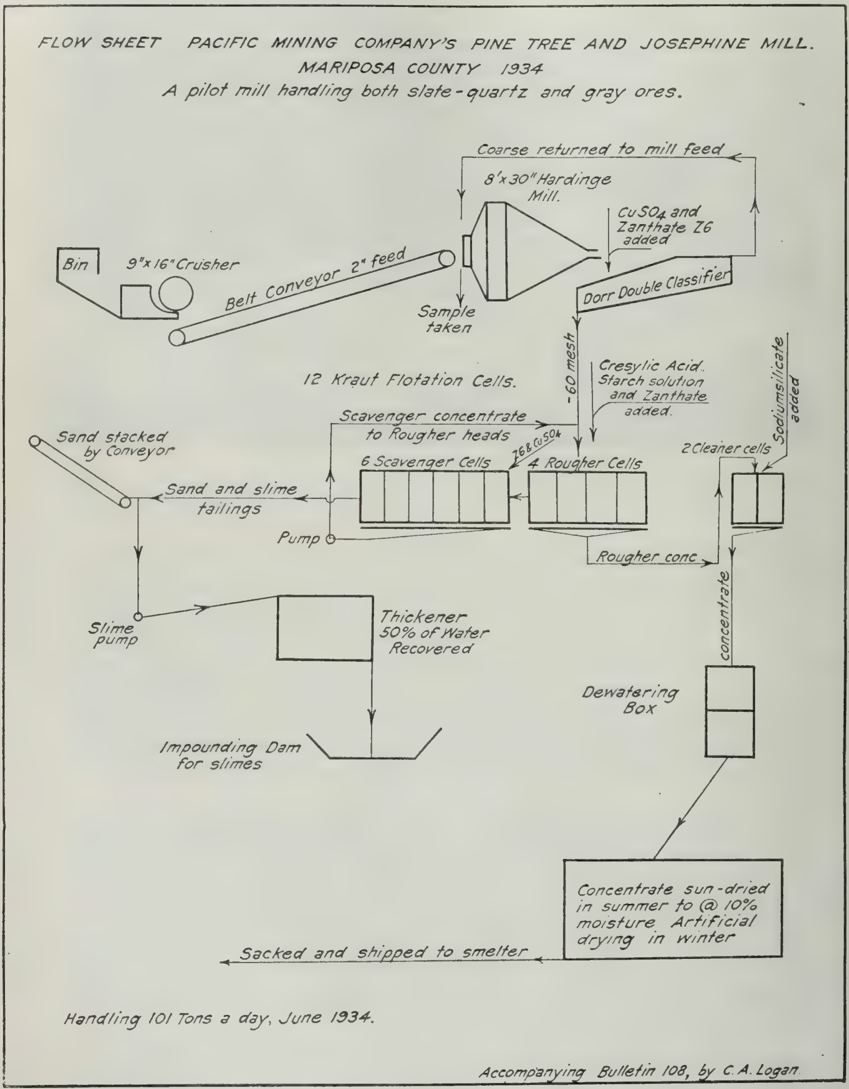
The mill is a straight flotation plant using Kraut cells (see flow sheet). Water is obtained from Merced River by pumping to a storage tank, vertical lift 1200 feet. Mill extraction for the month of November, 1934, was 94 per cent.

The entire development of this property is preparatory to operation on a much larger scale, as regards both mining methods and milling, if results warrant. Indications are favorable. Thus far it has become the largest mining enterprise in the county and it may easily develop into one of, if not the largest, on the 'Mother Lode' as Pacific Mining Co. is ably managed and adequately financed.

Bibl: State Mineralogist's Reports XXIV, pp. 91, 110; XVII, pp. 119, 133; XIV, pp. 584, 593; XII, pp. 173–174. Bulletin

No. 108, pp. 186–189. Mineral Resources west of the Rocky Mountains 1867, p. 43; 1868, pp. 27–28; 1869, p. 14; 1870, p. 23; 1875, p. 52. Trans. A. I. M. E. Vol. VI, pp. 145–164.

Quail Mine includes the Sunset, Bonanza, Mammoth, Juniper, Fairview and Star claims and a mill site, in Sec. 16, T. 3 S., R. 17 E., owned by Bruschi Bros., of Coulterville. J. E. King of Sonora has recently taken it under lease and bond and has completed the necessary road work to permit reopening.


FLOW SHEET PACIFIC MINING COMPANY'S PINE TREE AND JOSEPHINE MILL.
MARIPOSA COUNTY 1934
A pilot mill handling both slate-quartz and gray ores.
Coarse returned to mill feed
8'x30" Hardinge Mill.
CuSO4 and Zanthate Z6 added
Bin
9"x16" Crusher
Belt Conveyor 2" feed
Sample taken
Dorr Double Classifier
-60 mesh
12 Kraut Flotation Cells.
Cresylic Acid. Starch solution and Zanthate added.
Sodiumsilicate added
Scavenger concentrate to Rougher heads
Sand stacked by Conveyor
Z6 & CuSO4
6 Scavenger Cells
4 Rougher Cells
2 Cleaner cells
Sand and slime tailings
Pump
Rougher conc.
Slime pump
Thickener 50% of Water Recovered
concentrate
Dewatering Box
Impounding Dam for slimes
Concentrate sun-dried in summer to @ 10% moisture. Artificial drying in winter
Sacked and shipped to smelter
Handling 101 Tons a day, June 1934.
Accompanying Bulletin 108, by C. A. Logan.

Bibl: State Mineralogist's Reports XIV, p. 595; XVII, pp. 134–135; XXIV, p. 112.

Red Bank Mine, in Sec. 36, T. 3 S., R. 16 E., is reported leased to a Mr. Draper who is soon to start work.

Bibl: State Mineralogist's Reports XVII, p. 135; XXIV, p. 113.

Red Cloud Mine. Fredericks and Hodge of Mariposa have taken an option on the Red Cloud, located in Sec. 22, T. 2 S., R. 17 E., 9 miles east of Coulterville. They expect to start pumping it out at once.

Bibl: State Mineralogist's Reports XVII, p. 135; XXIV, p. 113; XII, p. 175; VIII, p. 345.

Rex Mine (Recorder), in Sec. 20, T. 4 S., R.18 E., in the Colorado district, is under lease to Elmo W. Eidson of Midpines who has two men engaged in doing development work.

Bibl: State Mineralogist's Reports XVII, p. 135; XXIV, p. 113.

Robinson and Orr Group consists of 7 claims located in Sec. 21, T. 4 S., R. 18 E. in the Colorado district. Owners: Frank D. Robinson of Merced and N. P. Orr of Mariposa. The claims lie in a rugged area at an elevation of 2500 feet. There is some mine timber on the property and water is obtained from the tunnel.

Development began in October, 1932, and to date 700 feet of tunnel has been driven on the vein, and an air shaft put through. There is a crosscut on the vein 24 feet long which does not reach any definite walls and the width of the lode is uncertain. The deposit is in the form of quartz stringers in a dike of quartz porphyry, graphitic and talcose schist. The strike is NW.-SE., dip 80°. Greatest depth opened up below the surface 200 feet. All work has been done by hand drilling.

The mine is equipped with a small Lloyd ball mill and three Lynch concentrating tables operated by gasoline engine. Forty 5-gallon cans of concentrates are awaiting shipment. Four men are working.

Rutherford and Cranberry Group. These claims are held under lease and option by *Yosemite National Gold Mines Co.,* John C. McGarry, manager. A new 200-foot shaft has been sunk, road built and machinery installed. Development is continuing on the 200-foot level. At the time of visit (Armistice Day) the mine was idle and no one was on the property.

Bibl: State Mineralogist's Reports XIV, pp. 580, 596; XVII, pp. 112, 136; XXIV, p. 114; XIII, p. 222; VII, p. 348.

Ruth Pierce Mine in Sec. 13, T. 5 S., R. 16 E., 4 miles east of Hornitos, is idle, but 3 partners are treating the tailings in a small cyanide plant having a capacity of 20 tons a day.

Bibl: State Mineralogist's Reports XXIV, pp. 114–115; XIV, p. 596.

Santa Rosa Mine. This property is situated on Yosemite all-year highway one-quarter mile south of Bear Creek Lodge. It is owned by Stockton and Eckter, 930 E. Yosemite, Madera; local address: Midpines. Operations started in March, 1934. There are 23 acres in the property, developed by an old 300-ft. tunnel which has been cleaned out and another 100-ft. tunnel yet to be reopened; also 3 shafts, one 35 feet and two 50 feet deep, all in a quartz stringer zone from 7 to 20 feet wide, the vein having many cutters. The vein strikes NW.-SE. and stands nearly vertical. The ore carries free gold and sulphides. Equipment consists of a Lloyd ball mill and plates. After sorting out high-grade, the ore being milled averages $7.50 a ton. In addition to the vein being worked there are several strong cross veins of solid quartz entirely undeveloped. Three men are working.

Schroeder Group was taken under lease and option by Ashworth and Pehrson of Mariposa, in January, 1934. It is in Sec. 16, T. 4 S., R. 18 E., formerly reached by 2 miles of trail, but now by road connecting with the new Telegraph Mt. road. The Diltz mine is 2 miles distant in an air line. Several steep narrow veins occur which are cut by a nearly flat blanket vein. The latter has been tapped by an adit 215 feet in length. There is also a new 15° incline shaft down 35 feet. The operators are putting in a compressor and machine drills, and intend to move the small mill to the new adit level. Two men are working in the mine and 2 on the road.

Bibl: State Mineralogist's Reports XXIV, pp. 115–116; XIV, pp. 596-597.

Silver Bar Mine is in Sec. 15, T. 6 S., R. 19 E., about one-half mile north of the Silver Lane Mine. It was acquired by the present owner, Richard E. Jeffrey, in January, 1934. The shaft is down 253 feet, and sinking and drifting is being continued. The 100-ft. level is closed. On the 200-ft. level there is 400 feet of drifting.

The mine is equipped with a 40-ton straight flotation mill containing crusher, Huntington mill, rod mill and Kraut flotation cells. Heads average about $9 a ton and tails 25 to 30 cents with a trace of gold. Concentrates are shipped. Gasoline and stove-top oil are used for power. At the time of visit, shortage of water permitted operating the mill only one hour a day. A dam was being built in the creek to form a reservoir. Five men are employed.

Bibl: State Mineralogist's Report XXIV, pp. 123, 143.

Silver Lane Mine (formerly Wallman Ranch Property). The mine is in Sec. 15, T. 6 S., R. 19 E., about three miles south of Bootjack and is owned by Silver Lane Gold Mining Co., A. D. Lane, president and general manager; P. O. address: Ben Hur. It comprises 20 acres covering a length of 1320 feet along the lode, and timber rights on 320 acres. The present company began operations in the middle of 1933. Water is obtained from the mine, springs and creek, but it is very scarce in summer.

There is a quartz vein having an average width of four feet, striking NW.-SE. with dip to the south. The footwall is granite and hanging-wall granite and quartzite. It has been opened up by a shaft to a depth of 240 feet with a 92-foot drift east on the 85-foot level and another 80-foot drift east on the 200-foot level. No drifting west as yet. The ore is base containing arsenical and antimonical (ruby) silver sulphides, argentite, native silver and a very little free gold. Present ore reserves are stated to amount to approximately $60,000. Hoist and compressor are operated by steam-power as steam is used in the special ore chloridizing-roasting process of extraction. Tailings are cyanided. Equipment includes 50-ton crusher, 4 by 8 foot rod mill, roasting furnace and all necessary leaching tanks for the complete process, the final product being bullion. Three men are employed and others work under contract cutting wood, etc., as no mining was being done at the time of visit for lack of water.

Bibl: State Mineralogist's Report XXIV, p. 143.

St. Gabriel and Honeycomb Claims (silver-lead mine) are being worked by Sanchez Bros. The property is in Sec. 34, T. 4 S., R. 16 E. about five miles northeast of Hornitos.

Bibl: State Mineralogist's Reports XVII, p. 138; XXIV, p. 116.

Shaft and recovery plant at Silver Lane Mine, Mariposa County.

Sweetwater Mine, in Secs. 17 and 20, T. 4 S., R. 19 E. was taken over by *Hudson River Gold Mines, Ltd.,* late in 1933, and development has continued to date. It is equipped with a mill. Through unavoidable circumstances the writer was unable to visit it during the present field trip.

Bibl: State Mineralogist's Reports XIV, p. 598; XVII, p. 140; XXIV, p. 118.

Texas Hill Mine. Texas Hill Mining Company, a California corporation, has a lease covering the Carrie Todd and nine other claims in the Bull Creek district in Secs. 7 and 8, T. 3 S., R. 18 E.; P. J. McLaughlin, president; J. M. Christiansen, secretary; home office: Room 1112, 625 Market Street, San Francisco.

The property lies in a steep and rugged area on the east bank of the North Fork of Merced River. Elevation about 2400 feet. Operations by the present owners started March 2, 1934. The principal work so far has been confined to the Carrie Todd vein. This varies in width from 2 to 4 feet, between slate walls, strikes E.-W. and dips 75° N. It is opened up by tunnels. Drifting is being carried on in No. 2 tunnel to get under a block of high-grade ore.

The mine is equipped with compressors and machine drills and a 10-stamp amalgamation mill operated by gasoline and water power. From 10 to 16 men have been employed. Production to date (November, 1934) is approximately $6,000 from development work.

Virginia Mine (Virginia-Belmont), after a considerable period of activity under the direction of Grant Ewing, was closed down on November 1, 1934.

Bibl: State Mineralogists Reports XIV, p. 599; XVII, p. 141; XXIV, pp. 119-120.

During the year there has been much interest shown in the numerous old claims in the Bull Creek, Kinsley or Red Cloud district from 6 to 12 miles east of Coulterville, and a number of new discoveries also have been made in this area. A considerable number of these long-idle properties have been examined or sampled, some have been taken under lease and option, roads have been repaired and lumber and equipment placed on some, others are producing in a small way and several fair-sized operations have been started.

Among these properties are the Dexter, Argo, Bandarita (Bandaretta), Quail, Texas Hill, Martin-Walling, Last Chance, Marble Springs, Moonlight, Bondarant, Louisiana, Black Oak, Three Pals, Diana, Bunce (Big Dick), Big Grizzly, and others.

Individual 'snipers' are active on Sherlock Creek, Bear Creek, Saxon Creek, Aqua Fria Creek, Stockton Creek, Merced River, Sweetwater Creek, Black Creek, Mariposa Creek and at other points.

Hammon Dredging Project on Mariposa Creek.

In the latter part of 1934 the Bennett-Pate ranch of 700 acres in Secs. 1, 2 and 36, T. 6 S., R. 17 E. on Mariposa Creek in Mariposa County, with the Baher Ranch adjoining in Sec. 31, T. 6 S., R. 17 E. were leased to Walter E. Vaughn of San Francisco.

This ground was thoroughly sampled by drilling and the results showed definitely that Mariposa Creek does not contain values enough to justify dredging, and the Hammon Interests have abandoned the project.

The Smeyers Ranch in Sec. 30 and part of 31, T. 6 S., R. 17 E., also on Mariposa Creek and adjoining the above Baher Ranch, was drilled in 1907. Values here were also unsatisfactory.

BARITE

The large barite deposit (Egenhoff Deposit) situated in Sec. 17, T. 4 S., R. 20 E., is now owned by *California Barite Corporation, Ltd.*, 1206-8 Subway Terminal Bldg., Los Angeles. It is stated that since taking it over this company has spent $50,000 in development work. Idle at present.

MERCED COUNTY

Gold dredging operations on Merced River in the vicinity of Snelling, which ended in 1918, account for most of the several hundred thousand dollars in gold which this county is credited with producing up to that time. Production then practically ceased until 1930, when gold dredging again became active. There are now 2 dredges operating and 2 more under construction in the county, which is again becoming an important gold producer.

In 1933 it ranked sixth among the counties of the State in gold production.

Merced Dredging Company. R. W. Derby, manager; home office: 687 Mills Building, San Francisco, is completing construction of a new dredge in this area. It has a 52-foot by 110-foot hull, 8¼-cubic foot buckets and will be capable of digging to a depth of 25 feet. Dredging operations will start February 15, 1935.

Snelling Gold Dredging Company. C. H. Thurman, president, F. J. Estep, secretary, Snelling, California. This company controls approximately 1000 acres of dredging ground along Merced River in Secs. 10, 11, and 12, T. 5 S., R. 14 E. The company started prospecting in 1931 and No. 1 Dredge began working in April, 1932. The deposit consists of uncemented gravel and sand, with no clay. Some oak and cottonwood on the ground. The gravel is from 10 to 20 feet deep, and bedrock is lava ash. Dredging conditions are good, except that in shallow ground it is necessary to move frequently.

No. 1 dredge is of standard type. It has 7-cu. ft. close-connected buckets, 42 ft. by 96 ft. steel hull and ordinary riffle system. Maximum digging depth 25 feet under water. Electric power obtained from San Joaquin Light & Power Company is used, a total of 350 horsepower being required. Daily production is 6000 cu. yds. Some platinum is also recovered in the ratio of 1 oz. of platinum to 100 ozs. of gold. Sixteen men are employed.

No. 2 dredge, an exact duplicate of No. 1, is under construction. It is about 20% completed.

Yuba Consolidated Gold Fields, Merced Unit. This dredge was built by La Grange Gold Dredging Company in 1928. It was taken over, together with 840 acres of dredging land, in December, 1930, by Yuba Consolidated Gold Fields; F. C. van Deinse, president; home office: Balfour Bldg., 351 California St., San Francisco; local office: Snelling, Calif., and has been operated continuously since then as their 'Merced Unit.'

The company's holdings now approximate 1400 acres, covering bench gravels along the Merced River in T. 5 S., R. 15 E. The gravel varies from 18 to 36 feet in depth, averaging about 28 feet. There are no heavy boulders and the gravel is not cemented, but the formation is tight. Bedrock is slate at the upper end near Merced Falls, but in the middle and lower end of the tract it is lava ash. Electric power amounting to 550 k.w. is supplied by San Joaquin Light and Power Company. The buckets are of 9 cubic feet capacity and the dredge handles 200,000 yards a month. A little platinum is recovered with the gold. Thirty-five men are employed. O. E. Coombs, superintendent.

STANISLAUS COUNTY

La Grange Gold Dredging Company. A new gold dredge was placed in commission by this company in August, 1934. Officers are Henry Eickhoff, Jr., president; Jefferson J. Doolittle, secretary; R. W. Derby, manager; home office: 687 Mills Bldg., San Francisco; field office, La Grange, Calif. The company owns 1,000 acres of dredging ground, 80 per cent of which has been worked, in Ts. 3 and 4 S., Rs. 13 and 14 E., covering river bars in the Tuolumne River. A peculiar feature of dredging in the river is illustrated by the fact that the present dredge is now digging within 100 feet of the exact spot a dredge was on in 1925, the bar having been rebuilt by the river.

Gold Dredge No. 4 of La Grange Gold Dredging Co., Stanislaus County.

Photo by courtesy of the company

In general, the gravel varies from 10 to 40 feet in depth, averaging about 25 feet. It is free washing. Bedrock is lava ash.

The dredge has a hull 52 by 120 feet and digs 32 feet in depth. Annual capacity 3,000,000 yards. Electric power is obtained from Turlock Irrigation District, a total of 700 horsepower being required. Thirty-five men are employed.

Indications are that the future will see additional gold dredging operations along the eastern border of the San Joaquin Valley, possibly in Fresno, Madera, Mariposa, Merced, or Stanislaus counties as investigation of various areas is under way.

LOS ANGELES FIELD DISTRICT

W. B. TUCKER and R. J. SAMPSON, Mining Engineers

Reports covering the mines and mineral resources of all of the counties in the Los Angeles field division are now available, and field work at present is confined to investigations for special reports upon various economic minerals.

GEOLOGIC BRANCH

CURRENT NOTES

Olaf P. Jenkins, Chief Geologist

To a geologist the following report by J. Clark Sutherland, ''Geological Investigation of the Clays of Riverside and Orange Counties,'' is particularly noteworthy, in that it coordinates the occurrence of economic deposits of clay with the general geology of the region. All the deposits are apparently not only of one geologic period —the Eocene, but of one geologic horizon of the Eocene—the *Martinez formation.* This feature, it might be added, is not confined to Southern California but is characteristic in other parts of the State. Apparently the environment to the Eocene was more favorable for producing material which later became commercial clay, than that of any other geologic epoch in California. Mr. Sutherland's report was contributed by him to the Division of Mines without cost to the State.

Three manuscripts are now on hand, ready for publication when funds are available:

(1) ''Preliminary Study of the Composition of Native Metallic Gold,'' by Welton J. Crook, Professor of Metallurgy, Stanford University.

(2) ''A Geologic Section Across the Peninsular Range of Southern California,'' by W. J. Miller, Professor of Geology, University of California at Los Angeles.

(3) ''Crystalline Rocks of the Perris-Elsinore Region, California,'' by Paul H. Dudley.

These three manuscripts are also contributions to the Division of Mines.

GEOLOGICAL INVESTIGATION OF THE CLAYS OF RIVERSIDE AND ORANGE COUNTIES, SOUTHERN CALIFORNIA *

By J. CLARK SUTHERLAND**

OUTLINE OF REPORT

Page
ABSTRACT 51
INTRODUCTION 52
  Location of the Deposits 52
  Extent of Work 53
  Acknowledgments 53
CLASSIFICATION OF THE CLAYS 54
  Commercial Classification 54
    Fire-clays 54
      Plastic fire-clay 54
      Non-plastic fire-clay, 'bone' and nodular fire-clay 54
      Flint fire-clay 55
      Uses of Fire-clays 55
    Refractory bond clays 55
    Red-burning clays 55
  Genetic Classification 56
GENERAL GEOLOGY 57
  Stratigraphy 57
    Basement complex 57
    Mesozoic formations 58
    Tertiary formations 58
      Martinez—Santa Ana Range 58
      Martinez—Elsinore Temescal Valley District 59
  Structure 61
DESCRIPTION OF THE CLAY DEPOSITS 62
  Temescal-Elsinore Valley Clay Deposits 62
    Local geology 62
    Alberhill District clays 65
      1. Yellow top clay 65
      2. Main tunnel clay 65
      3. Coal stratum 67
      4. Bone clay, or SH 4 clay 68
      5. Red-burning clays 69
    Other deposits 70
  McKnight-Corona Clays 75
    Local geology 75
    Description of the clays 77
  Goat Ranch or Claymount Clays 79
    Local geology 79
    Description of the clays 80
  Serrano or El Toro Clays 81
    Local geology 81
    Description of the clays 83
SUMMARY AND CONCLUSIONS 86

ABSTRACT

One of the three major clay-producing districts of California lies in Riverside and Orange Counties. The more commercially important clay pits and mines are distributed in the form of a horseshoe, whose axis, trending northwest-southeast, roughly coincides with the crest of

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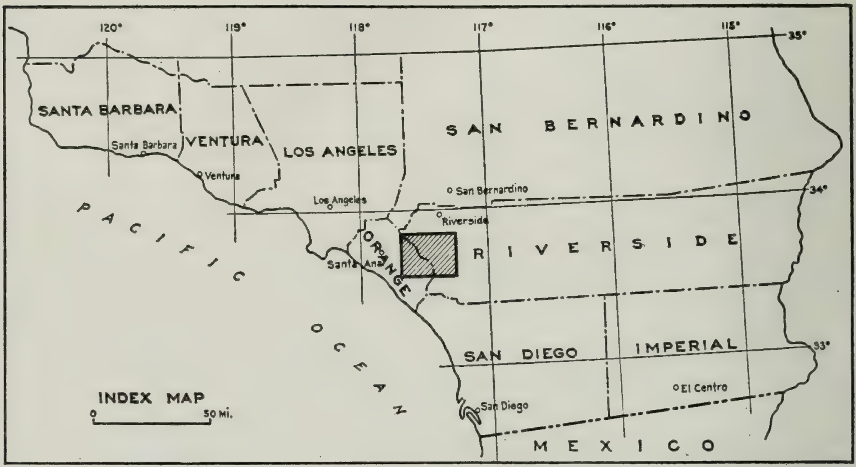
* Portion of thesis submitted in partial fulfillment of the requirements for the Degree of Master of Science to the Balch Graduate School of the Geological Sciences, California Institute of Technology, Pasadena, California.

** Economic Geologist, Pasadena, California.

the Santa Ana Range. The eastern limb lies in the Elsinore-Temescal Valley. The apex or closed end corresponds with the northern tip of the range, while the western end lies in the foothills of the Santa Ana Mountains.

According to ceramic use, these clays comprise many types but all can be classified into three broad divisions, namely, fire-clays, refractory bond-clays, and red-burning clays. Although more than thirty different clays are mined within this area, no one clay is used alone, all clay wares produced being a mixture of two or more separate types.

According to origin, both residual and transported clays are present. All of the transported and a portion of the residual types apparently belong, geologically, to one Tertiary formation, known as the Martinez, of Eocene, age. The clays are thus a part of a sedimentary series, considered to have been deposited under estuarine conditions at the edge of a gradually encroaching sea. Coal is found in close association with all of the transported clays. Its presence indicates that a humid-temperate climate existed when these clays were deposited. Although the presence of organic acids undoubtedly played a part in the formation of some of the clays derived from the original materials, certain other types of the residual class can not be explained in this manner, since they are not associated with coal. Volcanic material of a rhyolitic type has been found to be present both *in situ* and in the sediments and to have been altered in place, thus giving rise to the formation of residual and transported clays, which are bentonitic when derived from tuffaceous material.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Los Angeles
SAN BERNARDINO
San Bernardino
Riverside
RIVERSIDE
ORANGE
Santa Ana
PACIFIC OCEAN
SAN DIEGO
San Diego
IMPERIAL
El Centro
MEXICO
INDEX MAP
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50 Mi.

FIG. 1. Index map of the area described in this report on clay deposits of Orange and Riverside counties.

INTRODUCTION

Location of the Deposits.

The most important clay-producing areas in southern California are confined to three counties, namely, in rapidly decreasing order of importance, Riverside, Orange, and San Diego. Only a few of the more important occurrences in Riverside and Orange counties are described in this paper. For further discussion of individual deposits the reader is referred to the excellent state report by Dietrich.[1]

The Elsinore and Corona topographic quadrangles of the U. S. Geological Survey cover the area under discussion. The general localities of the clay-producing properties may be found on Plate 1.

Extent of Work.

Although the deposits have been described by Dietrich, Ries,[2] Linton,[3] Hill,[4] Burchfield,[5] and others, very little geologic work has heretofore been published on the clays of southern California, considering this area as a unit.

This report embodies information gathered in the field in 1929, 1930 and 1931. It describes the general geologic structure of the area, the stratigraphy which has a bearing on the origin and conditions of deposition of the clays, and the details of the more important types of deposits. While some of the problems of the origin of the clays are herein considered, it is intended that a more extended discussion will be published later, following the completion of a projected program of research.

Acknowledgments.

General supervision of the early part of the work was helpfully contributed by the staff and graduate student members of the Balch Graduate School of the Geological Sciences of the California Institute of Technology, Pasadena, California. Doctors J. P. Buwalda, Rene Engel, F. L. Ransome, W. P. Woodring and B. N. Moore are deserving of particular mention.

A considerable proportion of the data published herein was collected during the time the author held the position of consulting geologist for the Pacific Clay Products Company of Los Angeles, Calif. This discussion is, in reality, a continuation of a program of research initiated by Mr. Robert Linton of the Pacific Clay Products, and acknowledgments are due to him and his company for permission to publish this manuscript. William McClintock, Charles McClintock and Gus McClintock of that organization also contributed many suggestions and extended various courtesies.

Acknowledgments are also due to Dr. A. O. Woodford, Mr. William Hill and Mr. P. H. Dudley of Pomona College for their interest and cooperation.

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[1] Dietrich, W. F., Clay resources and the ceramic industry of California: Calif. State Div. of Mines and Mining, Bull. 99, 1928.

[2] Ries, H., Clays, their occurrence, properties and uses: 3d Edition, John Wiley & Sons. 1927.

[3] Linton, R., Tertiary Clays of Southern Calif.: Jour. Am. Ceram. Soc., vol. 11, No. 10, 1928.

[4] Hill, J. H., Clay deposits of the Alberhill Coal and Clay Co.: Calif. State Mineralogist, Report XIX, 1923, p. 185-210.

[5] Burchfield, B. M., Refractory clays of the Alberhill, California deposits: Jour. Am. Chem. Soc., vol. 6, 1924, p. 1167.

CLASSIFICATION OF THE CLAYS

COMMERCIAL CLASSIFICATION

Generally speaking, the clays found in the areas described in this report comprise three main commercial groups: (1) fire-clays, (2) refractory bond clays, and (3) low-vitrification point red-burning clays.

Fire Clays.

The term fire-clay, properly speaking, refers to those clays capable of withstanding a high degree of heat. They are divided into three classes: plastic, nonplastic and flint fire-clays. They may or may not possess a high degree of plasticity. Those fire-clays which possess good plasticity, and good bonding powers when wet, dried or fired are generally placed by ceramists in a separate division, i.e., refractory bond clays. The fire-clays of this district have a fusing point above cone 27 (1605° C.) and a fairly small shrinkage.

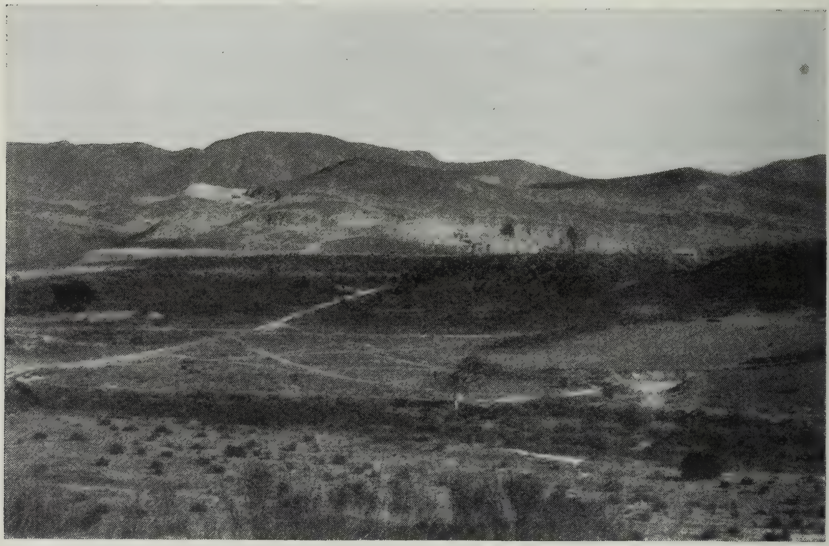

FIG. 2. Alberhill district looking east across the valley. The Alberhill mines are located in the hill in the middle distance. The large pit in the center is the Main pit, the one at the north side (left) is the Douglass pit. In the right foreground is the Pink Mottle pit of the Los Angeles Brick Company.

Plastic Fire-Clay. The plastic fire-clay group overlaps the refractory bond clays, and different manufacturers use the same clay for the two purposes. In general, plastic fire-clays possess a smaller shrinkage and a smaller fired strength than the bond clays, and usually are simply bond clays contaminated by a larger amount of sand. Plastic fire-clays contain a low percentage of fluxing impurities such as iron oxide, lime, magnesia and alkalies, and are invariably white or gray in color.

Non-plastic Fire-Clay, 'Bone' and *Nodular Fire-Clay.* The nonplastic fire-clays include for the most part those clays known as 'bone' to the ceramist of the western States. The distinguishing characteristic of bone, aside from nonplasticity, is its pisolitic structure, which may vary from a few irregularly spaced angular grains included in the clay, to a solid mass of rounded pisolites. The presence of these globular concretions have been taken in common geological usage to indicate the presence of gibbsite, or diaspore. Petrographic examination of thin sections of this material, however, failed to yield any substantiation of this supposition, although it was noted that the presence of the rounded pisolites invariably indicated a high alumina content which may be due to the presence of bauxite or amorphous alumina hydrate.

Flint Fire-Clay. The flint fire-clays develop but little plasticity even when aged. They are hard and flint-like, with a smooth conchoidal fracture, and possess a very dense texture. It is not known in what specific characters the flint fire-clays differ from the ordinary plastic fire-clays. In this district, however, the original materials of the flint fire-clays are believed to have gone farther along in the process of decomposition and elimination of impurities. Further, the flint fire-clays are only found in areas in which the sediments have suffered a comparatively greater amount of diastrophism. The physical characters of the clays of this type may be due to recrystallization of the mineral components of the clay in this horizon.

Uses of Fire-Clays. There is almost an endless variety of refractory clays. In general, they are employed in mixtures used in the manufacture of various shapes of fire-brick, locomotive and furnace linings, saggers, etc. Some of these wares must resist heat alone, others rapid changes in temperature, abrasion, or chemical corrosion; many are called upon to resist compressional forces while at a high temperature. Consequently, the aim of the manufacturer is to select a mixture of clays which will give a ware best adapted to resist the environment under which it is to be used.

Refractory Bond Clays.

The refractory bond clays include those clays which, in addition to their refractory character, have a strong bonding power. The small amount of ball-clays found in this district are included under this class. In general, clays in this class should have a high transverse strength and should be able to bind together materials of less cohesiveness. In the area concerned the plastic fire-clays are in reality bond clays which, by reason of the sand included in the material, can not to any great extent be further admixed with low strength materials. Therefore the qualities described under plastic fire-clays also apply to this class. In addition to their use in refractory shapes, the refractory bond clays are also widely employed as a plasticizing agent in whiteware mixtures.

Red-Burning Clays.

The low-vitrification-point red-burning clays include those materials which contain sufficient iron oxide and other fluxes so that they have the properties their name implies. They usually represent material which was originally more impure or insufficiently decomposed and leached, either in place, previous to transportation, or during transportation. In a few cases, the presence of fluxes is due to contamination by solutions bringing impurities from the outside, and depositing them in the pore spaces of the materials.

The specifications of this type of clay are as follows: good plasticity, ability to dry and burn without warping or cracking, well-dried or burned transverse strength, freedom from lumpy impurities and soluble salts, and ability to take a salt-glaze.

The uses of this type of clays are innumerable. Any product in which a red color or low vitrification temperature are desired, may usually be made of this material. Sewer pipe, common brick, hollow and roofing tile, electric conduit, and red pottery are examples.

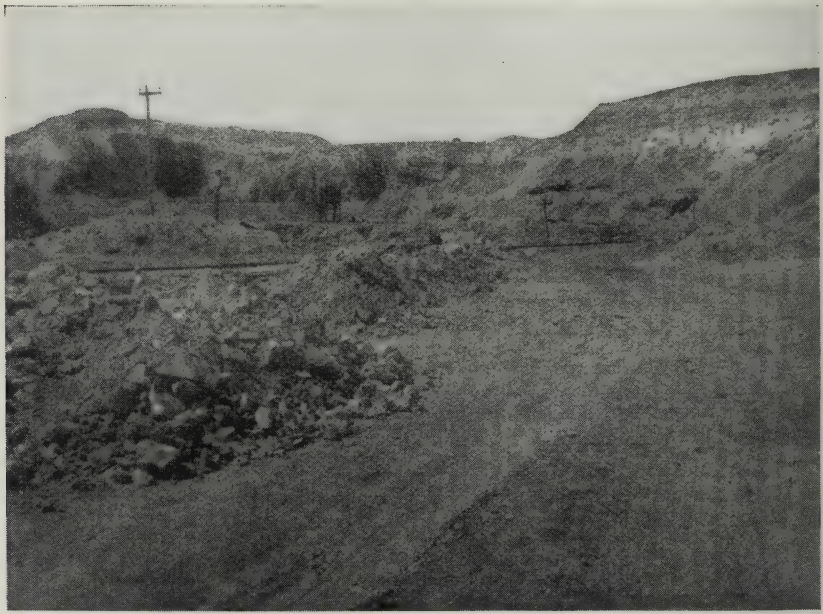

FIG. 3. Main pit at Alberhill. This is the largest clay mine in California. The beds of transported clays exposed, that have been mined, comprise a total thickness of over 50 ft. (right) and are cut off by a north-south fault (left center).

GENETIC CLASSIFICATION

According to origin, the clays found in the district may be divided into two main classes: (1) residual clays and (2) transported clays. Residual clays include those which have developed by alteration in place of the source material, while transported clays are those which have been produced by alteration before or during transportation. Minor secondary changes have taken place in the clays of both classes.

Most of the clays in the district, including all of the purer types, belong to the transported class. Thus fire-clays and refractory bond clays represent the transported class, while the red-burning clays may belong to either the transported or the residual class. Examples of the transported class include all of the Corona-McKnight, Goat Ranch-Claymont, Serrano El Toro, and most of the Alberhill types of clay. Residual clays are represented by the Wildomar, and portions of the Alberhill group.

Some of the clays dealt with in this discussion might be termed bentonitic in the sense of their origin. That is, they are considered to be the result of chemical alteration and devitrification of the glassy particles of tuffs. The term, however, as used here does not necessarily connote the physical properties of swelling, etc., which the nontechnical use of the word implies.

GENERAL GEOLOGY

STRATIGRAPHY

Basement Complex.

Practically all of the ranges in southern California contain a great variety of metamorphic and igneous rocks. According to Engel,[6] the east and west sides of the Elsinore and Temescal valleys are made up of metamorphics, mostly slates, quartzites and phyllites composing the Santa Ana formation of upper Triassic age, and associated with acidic extrusives also metamorphosed. These rocks are intruded by diorite and various hypabyssal rocks, notably a quartz latite-porphyry which is well developed on the eastern side of the Elsinore trough. This whole assemblage is in turn intruded by granodiorite forming stocks and a batholithic mass which is exposed along the western edge of the Santa Ana Mountains, and which includes patches of quartz monzonite and gabbro. In his work on the northwestern portion of the Elsinore quadrangle, Dudley[7] gives a similar composition to the basement complex of his area. Moore states that the material making up the old rocks of the Santa Ana Range is a complex series of slates, tuffs, andesites, granodiorites and many other rocks.

The igneous rocks of the basement complex of the entire region have thus plagioclase feldspars dominating over the orthoclase. This fact has an important bearing on the origin of some of the clays. Previous to the extensive investigations by Engel, Moore and Dudley, little was known concerning the nature of the basement complex, and most of the clays were considered to have been derived from orthoclase feldspar by its decomposition.[9] The present results, however, indicate that those clays which are derived from alteration products of the rock masses over a large distributive province came from plagioclase rather than orthoclase feldspar.

Overlying the basement complex are Cretaceous sediments, entirely unaltered. Thus the rocks which are intrusive are probably to be correlated with the Jurassic batholith of the Sierra Nevada.

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[6] Engel, Rene, Geology of the southwest quarter of the Elsinore quadrangle: Geol. Soc. Am. Bull. 43, p. 225, 1932; and unpublished thesis, Cal. Inst. Tech., 1933.

[7] Dudley, P. H., The Geology of a portion of the Perris Block, Southern California: *Abstract*, Geol. Soc. Am. Bull. 43, p. 233, 1932.

[8] Moore, B. H., Geology of the southern Santa Ana Mountains, Orange County, California: Pan. Am. G., 1 vol. vol. 54, p. 69, 1930; and unpublished thesis, Cal Inst. Tech., 1930.

[9] Linton, Robert, Tertiary clays of Southern California: Jour. Am. Ceram. Soc., vol. 11, No. 10, 1928.

Mesozoic Formations.

Aside from a series of considerably metamorphosed sediments which are, at least in part, of Triassic age as previously stated,[10] the only other part of the Mesozoic which is stratigraphically represented in this region is the Cretaceous, whose sediments overlie both the basement complex and the Triassic metamorphics with profound unconformity. The following description of the characteristics of the Cretaceous in the Santa Ana Range has been largely contributed by B. N. Moore in the course of cooperative field work.

In the Santa Ana Range province, the Cretaceous sediments fall into two main groups, the Trabuco and the Chico. The Trabuco formation, Lower Cretaceous, is a red conglomeratic and arkosic sandstone. It averages about 200 feet thick. The Trabuco, because of its red color and lithologic character, is generally considered to be continental in origin, but is thought by Moore to be marine.

The Chico, Upper Cretaceous, is undoubtedly marine, and consists of three divisions: (1) a series of well-indurated conglomeratic sandstone, much harder and lighter in color than the Trabuco, and which contains conglomeratic lenses consisting of extremely well rounded pebbles of quartzites, slates, and a considerable range of basic igneous rocks, similar to the Chico formation found elsewhere along the southern west coast; (2) an overlying series consisting of a considerable thickness of sandstone, in turn grading into several hundred feet of finely laminated shales which are blue when fresh, and gray when weathered; (3) a series, uppermost in stratigraphic position, consisting of sandstones with conglomerate and shale lenses. The total thickness of these Cretaceous beds ranges from two to three thousand feet, depending upon where the section is measured. The lithology and induration of the Chico is fairly distinctive and it is easily identified in the field. The coal mines of the Santa Ana Mountains, which were mapped by Dickerson[11] as Cretaceous, apparently are to be more properly classified in the Martinez Eocene.

So far as known, Cretaceous formations do not outcrop in the Elsinore and Temescal Valleys further southeast than Eagle Canyon, near Corona, and it is a question whether or not the Cretaceous sea extended into this province.[12]

Tertiary Formations.

Martinez—Santa Ana Range.

The Cretaceous or older formations are unconformably overlain by the Martinez formation of Eocene age. Since all of the clays in the entire district described in this paper in both the Santa Ana Range and the Elsinore-Temescal Valleys are intercalated in the Martinez, this formation is particularly important.

The Martinez of the Santa Ana Range is of continental origin in its lower part but marine in its upper. It differs from the Cretaceous in its lighter color, which is buff or light green, and its comparative lack of induration. Furthermore, it is distinguished from all the other formations in the entire district by its content of a considerable amount of chlorite.

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[10] Reed, R. D., Geology of California: Am. Assoc. Pet. Geol., 1933.

[11] Dickerson, R. E., The Martinez and Tejon Eocene and associated formations of the Santa Ana Mountains: U. of Cal. Pub. Geol., vol. 8, No. 11, 1914.

[12] Engel, Rene, Personal communication, 1929.

The basal bed of the formation is a coarse conglomerate which has unmistakably derived its materials from the underlying Cretaceous. It consists of well rounded pebbles, similar to those of the Chico conglomerates, admixed with boulders of conglomerates, sandstones and shales, which also exhibit Cretaceous lithologic characters, the shales being particularly distinctive. The sources of these materials must have been rather near at hand, for it is inconceivable that the shales would long resist complete breaking up in such a ball-mill as the bottoms of the streams would have been in the presence of the well rounded pebbles of the conglomerates.

The basal conglomerate grades upward into a variable thickness of subangular arkosic sandstone which in turn gives place to shales, these generally being lignitic in character. Occasional lenses of coal are found containing unbroken fossil reeds which give evidence of the material having been formed in place. The clay horizon, traceable for a distance of over eight miles, is associated with lignitic shales. The presence of the coal would seem to indicate favorable horizons for end-products of the alteration of the silicates to hydrous compounds. The sharp change in the characters of the materials within the clay horizon, in comparison to the strata above and below, is best accounted for by a sudden change in the facies of the clay bed, the scattered quartz grains indicating considerable alteration in place of material originally arkosic sandstone and conglomerate. Well-sorted and bedded marine sandstones, remarkably constant in character, overlie the shales and contain thin lenses of conglomerates resembling the basal bed. They also contain calcareous lenses with distinctive Martinez invertebrate marine fossils, including such types as *Turritella pachecoensis* Stanton.

The entire Martinez formation of the Santa Ana Range, both above and below the shales, is characterized by the presence of chlorite, which is considered to be a distinctive feature of that formation.

Martinez—Elsinore-Temescal Valley District.

The clays of the Elsinore-Temescal trough lie directly upon or very close to the basement complex. They possess a much greater thickness and diversity of ceramic use than the clays of the Santa Ana Range. All of the more valuable residual clays, so far as is known, are the result of alteration in place of rhyolitic rocks, or of subaqueously deposited volcanic breccias and conglomerates. The transported clays are derived from the alteration of materials in part volcanic previous to deposition.

The age of the non-transported rhyolites was not determined at any locality. The sedimentary materials occur in the Martinez formation. The effusive activity, giving rise to the volcanics found in connection with the clays of the sedimentary series can only be said to be pre-lower Martinez, and is not definitely set as to age.

The clays occurring in this sedimentary formation, whether residual or transported, ordinarily lie directly upon the basement complex. In the few places they overlap other sediments, which are also non-marine, these underlying beds consisting of fine-grained and well-sorted sandstones and carbonaceous shales, laid down in shallow fresh water or brackish water.

The clay horizon in the Alberhill district, consists of two members: (1) a series of red-burning residual clays comprising altered rhyolitic conglomerate and other materials which rest directly upon the schists and intrusives of the basement complex, which in a few places is sufficiently altered to be used as a low grade clay; (2) a series of much higher grade transported clays consisting of fire-clays and refractory-bond clays closely associated with carbonaceous clays and lignite. In some cases the last series only is present, resting directly upon the basement complex.

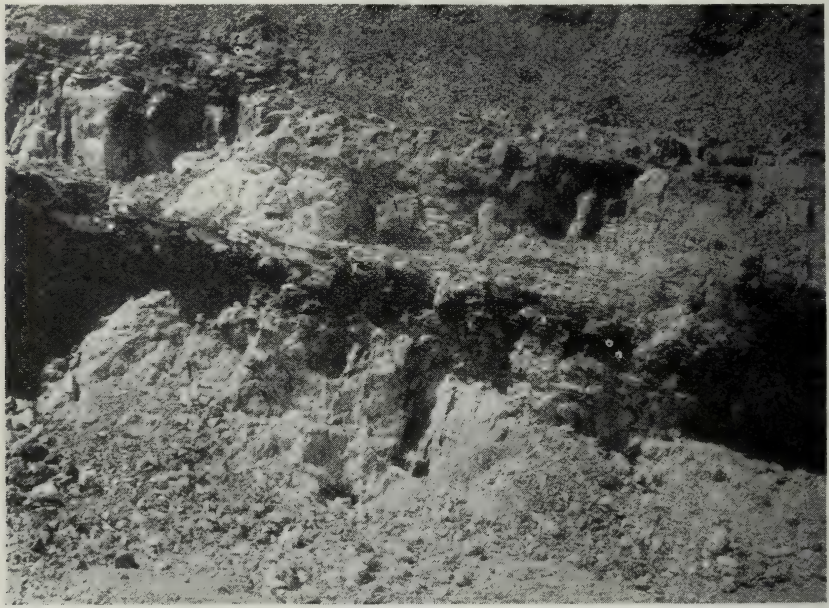

FIG. 4. Near view, illustrating character of clay and vertical variation in beds, which necessitates hand-mining methods. Plastic fire clay occurs above and below a thin bed of coal. Picture taken at outer edge of a coal lens, at upper end of Douglass pit in Alberhill district. The lignitic coal bed here shown is in some places over 8 ft. thick, and the early mining was for coal, not clay.

Above the clay horizons occur sandstones and shales possessing the same lithologic characters as the marine Martinez sediments which lie above the clay strata of the Santa Ana Range. The formations within the Elsinore-Temescal Valley trough, however, are so badly broken by post-clay faults, that correlation of the clays with other beds of a known age is rendered difficult.

The only fossils which have been found in the clays themselves consist of reeds and other plants, but these do not indicate the age of the deposits. As called to the attention of the writer by Rene Engel in the spring of 1930, in the vicinity of Lee Lake, a marine invertebrate fauna, containing *Turritella pachecoensis* Stanton and positively identified as Martinez, occurs in fine-grained sandstones overlying the clays of the Twin Springs area. A brackish water fauna collected from the bottom of a well at Terra Cotta, immediately southeast of Alberhill, consists of the pelecypod, *Cyrena*, [13] of doubtful correlating value.

The determination of the age of the clays of the area south of Twin Springs rests upon lithologic evidence permitting the correlation of the clays of Twin Springs with those of Alberhill. On the basis of the present data they are also placed as Martinez Eocene. Like the Santa Ana Range and the Twin Springs clays they were deposited in the transitional zone between marine and non-marine facies and are in themselves of brackish water origin. Abundant grains of chlorite are found throughout the stratigraphic series which contain the clays of both localities. Furthermore the clays of both provinces are associated with lignite or carbonaceous clays, and the presence of coal in Southern California is commonly assumed to denote Eocene. Also, sediments determined as Martinez by their marine fauna, occur in close proximity to the Twin Springs clay mine. The fossil horizon and the clay series below, seemingly bear a close relationship and also correspond to the marine and non-marine facies of the Martinez of the Santa Ana Range.

STRUCTURE

The structural relationships of the geologic units involved in this area indicate that the most recent form of failure of the earth's crust has been in block-faulting. In the individual clay pits, the question as to whether folding of the sedimentary formations in which the clays are intercalated is primarily dependent on and caused by faulting movements or is pre-faulting, can not be generalized upon because of conflicting evidence. In some of the clay pits evidence is seen of a period of rigorous folding preceding the block faulting which gave rise to the present mosaic, in others the major folding is unquestionably caused by strong fault movements. In those areas which are not faulted, the geological relations of the clays are rather simple.

The clays outcrop discontinuously in a horseshoe-shaped pattern whose open end points southeastward. The clay pit localities extend up the Temescal-Elsinore Valley, across on the northern end of Santa Ana Range, and southward down its western slope. The sediments form a broad northwest-southeast syncline in the Elsinore and Temescal Valleys, this structure probably being pre-faulting and locally accentuated by drag-friction to movements along the faults bordering the graben-valley depression. North of Alberhill, this syncline is further warped by folds, the axes of which are transverse to the valley axis, and is also cross-faulted [14] so that the clay horizons are repeatedly exposed.

Commercial clays also crop out immediately northwest of the Santa Ana Range fault block, in the foothills of that range, and southwest of the town of Corona. The principal locality in which these clays have been exploited is the McKnight-Corona Mine, where the clay-bearing series is broken by vertical, flat-thrust, and possibly horizontal faults, coupled with intense folding and shearing. The complexity of this structure may be explained by the fact that this locality is near the meeting point of the Chino, Whittier and Elsinore faults.

The clays of the Goat Ranch-Claymont Mine, at the northern tip of the Santa Ana Range, apparently belong to the same horizon of the

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[13] Determined by Mr. W. P. Popenoe, curator of invertebrate paleontology, Calif. Inst. of Tech., on material collected by the writer in 1929.

[14] Engel, R., *Op. Cit.*, 1933.

Martinez as those of the McKnight, but exhibit no such complexity of structure. Although cut by minor faults, they rather simply dip northward down the mountain slope toward the Santa Ana River.

The beds lapping up on the westward tilted fault-block of the Santa Ana Range swing southward from the Goat Ranch locality. In the central portion of the range, the formations regularly dip westward away from the peak-forming granitic core of the mountain block. The Martinez formation is thus exposed in a broad belt which regularly parallels the contact between the basement complex and the sedimentary rocks of the Cretaceous to the east. A bed called the Serrano-El Toro clay, which belongs to the Martinez formation, crops out regularly over a considerable distance, and reveals the simplicity of the structure of the sediments of the range.

DESCRIPTION OF THE CLAY DEPOSITS

TEMESCAL—ELSINORE VALLEY DEPOSITS

The clays found in the Temescal-Elsinore valley trough make it one of the three most important clay-producing areas in the State of California as regards quality, variety of material, and tonnage mined. Production from this area has steadily increased until in normal times over 100,000 tons a year of over 30 distinct varieties of clay are mined by five major operators. This wide variety of clays is largely produced from three localities, though numberless pits, scattered throughout the valley, attest its potential resources.

That portion of the Temescal-Elsinore Valley from which clays have been taken comprises an area 30 miles long and 2 miles wide, running from the town of Corona on the north to a point a few miles below Elsinore Lake to the south. Although the clays crop out over this wide area only in irregular patches among sandstones and shales in which they are intercalated, and vary widely in each outcrop, a surprising regularity and continuity of type is found in the materials from one pit to another.

Local Geology.

The only formations which crop out in the valley are schists, quartzites, and their intrusive rocks, all of which are referred to the basement complex, and a series of Tertiary sandstones, shales, and clays. At least a part of the metamorphosed sediments are Triassic in age. They consist mainly of thinly-laminated siliceous phyllites which usually strike in a direction parallel to the valley and dip steeply. Massive quartzite beds are intercalated in these schists, which are at times extremely fissile and weather into thin flakes resembling in appearance the siliceous shale found in the Modelo or Monterey formations. The schists do not resist erosion as well as the quartzite lenses which stand out prominently as reefs. Occasionally they have been sufficiently altered to allow of their use as a low grade ceramic material.

A portion of the Tertiary sedimentaries are Martinez in age, and they resemble the outcrops of that formation in the Santa Ana Mountains. In general, however, the Martinez of the latter district appears to be somewhat better sorted, the individual beds of shales, sandstones and very infrequent conglomerates being slightly more clearly defined.

Underlying the known Martinez horizon occur a series of similar sandstones, shales and clays, also classed as Martinez, though they are thought to be for the most part continental in origin, as is the lower portion of the Martinez of the Santa Ana Mountains. They consist of well-sorted and bedded arkosic sandstones containing considerable amounts of chlorite, muscovite, and biotite, the chlorite being by far the most frequent of the micaceous minerals, and whose presence indicates the Martinez.

The continental origin of the sediments in which the clays are found is evidenced by the presence of fossil reeds, roots, and upright trunks of trees found in an impure coal bed in the clays. Brackish water fossil pelecypods, which are referred to the genus *Cyrena* were found in a bed of shale at the bottom of an old well at the abandoned tile plant at Terra Cotta, about 30 feet stratigraphically below beds containing leaf impressions collected across the road from the plant. The dip of the beds containing this fossil assemblage, if continuous, would carry them into the same series in which is intercalated the clay horizon.

The sediments overlying the clays gradually assume marine characteristics, similar to the known Martinez of the valley, which may best be studied at a fossil locality situated on the nose of the spur above the Santa Fe tracks south of the gas station at Lee Lake. The fauna include giant *Venericardia,* and *Turritella pachecoensis* Stanton.

Overlying the pre-Quaternary formations occur patches of Quaternary alluvial materials whose thickness varies between wide limits. Streams that normally flowed westward but were unable to maintain their courses across the rapidly rising central portion of the Santa Ana Range, were diverted along the base of the scarp, bevelling the softer sediments underlying the graben valley floor. In response to further diastrophism, the pattern of the streams was further changed, creating the present sag-ponds, of which Elsinore Lake is a notable example. The deposits of these former streams have been considerably dissected by intermittant creeks running out of the steep canyons normal to the valley. The materials making up these remnants consist of boulders of the igneous rocks of the basement complex, imbedded in a matrix of arkosic sandstone containing weathered feldspar, quartz, muscovite, and biotite.

In structure, the Temescal and Elsinore trough is a complex graben[15] lying between the Santa Ana and Temescal Mountains. It is broken up into slices which follow the longitudal axis of the depression, with movement observable not only between the upthrown blocks on either side but also between smaller units in the valley itself. With but a few exceptions, only the down-thrown slices within the valley are topped by sediments, the mountains on either side having suffered sufficient erosion to carry away the overlying sedimentary series, thus exposing the basement complex.

Structure within the valley, aside from the complex faulting, consists normally of a synclinal fold, the axis of which is parallel to the valley. At Alberhill, for instance, the clays dip 5° to 12° SW. down the slope of the hill but come up on the other side of the valley.

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[15] Engel, Rene, Preliminary notes on the geology of Elsinore Valley: Bull. Geol. Soc. Am., vol. 39, p. 267, 1928.

The thickness of the clay member varies widely as a result of yielding to different modifications of stresses caused by adjustments of the earth's crust in response to powerful vertical and horizontal forces. Individual clay strata also thicken and thin, varying so much in thickness and in character that correlation of the individual beds between the different pits is rendered difficult.

Accurate classification and comparison, must, therefore, rest upon careful and elaborate laboratory investigation, in addition to the observations made in the field. As stated by Ross, Shannon[16] and Kerr,[17] the identification and study of the relationships of the minerals comprising any clay requires the coordinated study of chemical analyses, optical determinations, X-ray examinations and dehydration tests made on carefully selected samples. Although no such array of equipment was available in this investigation, thin sections were made and examined microscopically of materials representative of the principal commercial products of the district.

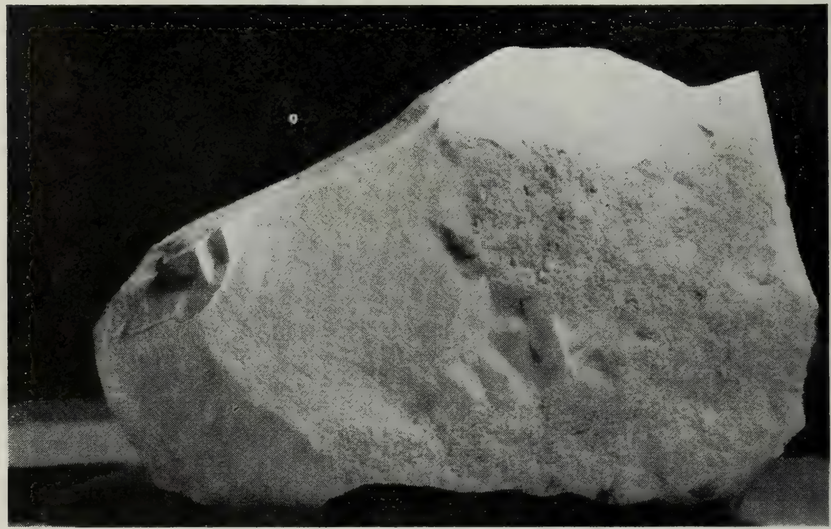

FIG. 5. Specimen of clay from upper portion of Main Tunnel stratum, showing blocky character and irregular patches of sand. The clay on the left would be classed as refractory bond, that on the right as fire clay, depending upon the amount of contained sand. Natural size.

The clay minerals were differentiated by petrographic examination in three groups: (1) the beidellite (leverrierite)—montmorillonite group, with an index of 1.53 to 1.54 and a moderately high birefringence of .042 to .022; (2) the kaolin mineral group, with an index of 1.566 and a low birefringence of .006; and (3) the halloysite group, with a variable index of 1.47 to 1.54, depending upon the amount of essential water present in the mineral, and completely isotropic. Winchell's[18] text was taken as the standard in classifications.

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[16] Ross, C. S., and Shannon, E. V., The minerals of bentonite and related clays: Am. Ceram. Soc. Jour., vol. 9, 1926.

[17] Ross, C. S., and Kerr, P. F., The kaolin minerals: U. S. Geol. Surv., Prof. Paper, No. 165, 1931.

Alberhill District Clays.

In each complete section in the Alberhill district, three main types of clay may be distinguished. These comprise all of the principal classifications of clays found in the Southern California area. Of these, the fire-clays and refractory-bond clays are universally of the transported class and are usually associated with coal. Most of the red-burning clays are residually derived from materials in part volcanic in origin and thus may be partially bentonitic. The following description is a representative section:

1. Yellow Top Clay. A slightly gritty, tough, blocky clay possessing good plasticity. It has had a good deal of limonite and vegetable acid staining, and finds its chief use in sewer pipe mixtures. About 20 feet of it is exposed at the main pit at Alberhill.

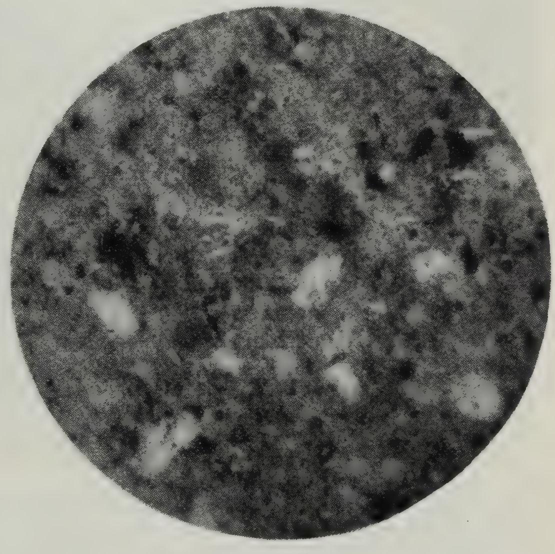

FIG. 6. Photograph of a thin section of clay of Main Tunnel. Specimen taken from bottom portion of bed, which is less sandy and more carbonaceous than the top part. Taken with ordinary light, magn. 100 x diam.

2. Main Tunnel Clay. This is a gray-white, blocky clay, possessing semiconchoidal fracture. It contains irregular patches of fairly coarse sand, particularly in the upper portion of the beds, the lower being finer and slightly carbonaceous.

The heavy minerals in this clay found by use of the microscope includes, in order of importance: magnetite, ilmenite, apatite, zircon, and tourmaline. A thin-section of the clay reveals coarse and quite angular sand particles. Their matrix is a fine-grained clay material in which montmorillonite and a brown fibrous mineral are by far the largest of the grains seen. Members of the kaolin family and halloysite groups are also present in considerable quantity, the matrix, in general, showing great change in light intensity between illumination by ordinary light and light passed through crossed nicols. An estimation of the percentage of the materials gives quartz 10%, montmorillonite-beidellite group 25%, halloysite group 25%, kaolin group 20%. The brown fibrous material mentioned above and which constitutes about 20% of the area, is probably a replacement of cellulose.

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[18] Winchell, A. N., Elements of optical mineralogy: John Wiley and Sons, 1933.

The following analyses of specimens of this clay have been furnished by the Pacific Clay Products of Los Angeles.

	Sandy Main Tunnel Per cent	Fine Main Tunnel Per cent
Ignition loss	6.97	12.34
SiO_2	72.56	59.32
Al_2O_3	18.73	25.67
Fe_2O_3	0.63	1.67
CaO	0.54	0.58
MgO	0.22	0.26
Alkalies	0.30	0.10

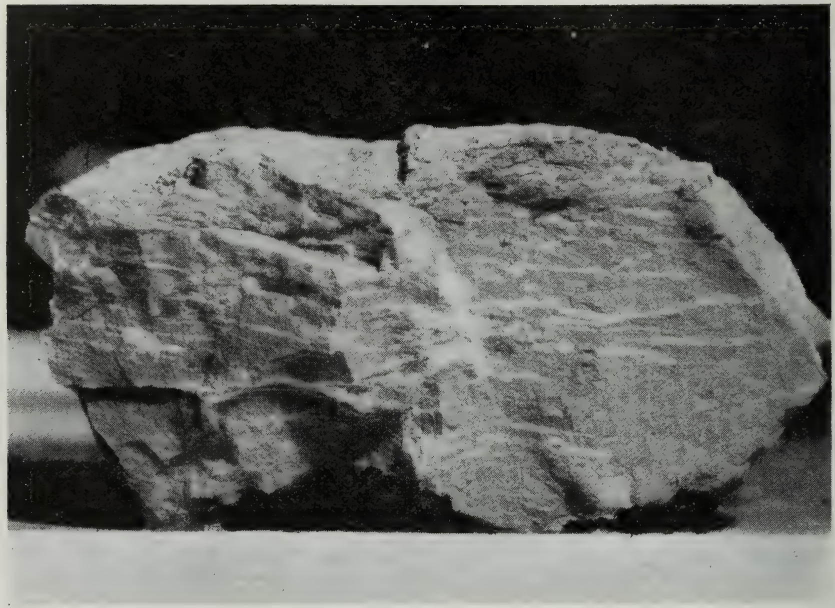

FIG. 7. Close-up of specimen of carbonaceous clay from Douglass pit which represents same horizon as lower portion of lignitic coal bed, and shows variations in the amount of finely disseminated carbonaceous material. This clay is very fine-grained, is extremely plastic, burns white and is highly refractory. Natural size.

Computation of the mineral analyses by the H. S. Washington [19] method gives the following results:

	Sandy Main Tunnel Per cent	Fine Main Tunnel Per cent
Quartz	49.5	28.6
Kaolinite	44.0	60.5
Serpentine	0.8	0.6
Limonite	0.7	2.8
Orthoclase	1.67	0.56
Anorthite	2.50	2.78
Ignition loss	0.63	3.4

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[19] Washington, H. S., Chemical analysis of igneous rocks: U. S. Geol. Surv. Prof. Paper, No. 99, 1917; and Jour. Am. Ceram. Soc. vol. 1, 405, 1918.

The ignition loss in the above and following tables is due, probably, to the presence of more hydrous minerals than kaolinite and to included carbonaceous material, in this case, the finer clay being particularly carbonaceous.

The field relations of this material would seem to indicate that the original rocks whose decomposition products furnished the clay of this bed were partly derived from the phanero-crystalline basement complex of the surrounding region, and partly from rhyolitic tuffs.

A very large quantity of this type of clay is mined. At the main pit at Alberhill, it is about 35 feet in thickness. The material possesses a good working plasticity but the amount of sand within the clay cuts down the plastic strength. It fuses at the fairly high temperature of cone 30 (1650°C). It is very widely used for fire-brick, terra-cotta, art-tile, and for similar purposes.

3. Coal Stratum. As was indicated above, the clays become finer towards the base of the Main Tunnel horizon. This clay is floored by an impure coal bed, portions of which were pure enough to justify mining in the past for lignitic coal. Other portions of the bed contain sufficient clay to be utilized as such.

A chemical analysis of an argillaceous specimen follows:

	Coal Crop, Per cent
Ignition loss	33.84
SiO_2	35.35
Al_2O_3	20.74
Fe_2O_3	2.52
CaO	0.90
MgO	0.15
Alkalies	1.18

Computation of the theoretical mineral content gives the following results:

	I Per cent	II Per cent
Ignition loss	30.1	----
Quartz	5.84	8.3
Kaolinite	48.8	70.0
Serpentine	0.67	1.0
Limonite	2.84	4.05
Orthoclase	7.00	10.0
Anorthite	4.45	6.4

The contained carbonaceous materials are lost in ignition, which accounts for its high percentage in column I. In column II, the figures represent the results obtained by eliminating the ignition loss and recalculating to 100%.

The average thickness of the coal stratum as exposed in the main pit at Alberhill is about six feet. It is, however, subject to considerable variations in thickness, but the more purely lignitic portions of the bed are much more constant in this respect than the relatively incompetent argillaceous parts.

The mines at Alberhill were originally opened by the combined families of Albers and Hill for the purpose of exploiting the coal. Inasmuch as eight feet of lignitic coal is present in some places, the project was somewhat successful, in spite of the high ash content of the material. In the early days, the lack of fuels of all kinds and the poor transportation facilities made even this low grade coal valuable, the clay being simply thrown aside. In later years, however, only the Mexican laborers mined the material for their own use.

Toward the top of the hill, the coal stratum grades into a carbonaceous clay bed which, occasionally, contains 'ghost' pebbles apparently of a material originally rhyolitic. Like the Main Tunnel Clay above them, these clays are considered to be mainly transported.

The argillaceous portion of the bed possesses an excellent smooth plasticity, medium-high dry strength, and, when fired, of a white or buff color. It softens at cone 30 (1650°C) and on account of its smooth texture and its excellent working and fired properties, it is widely used in art tile, sagger and dry-pressed brick mixtures.

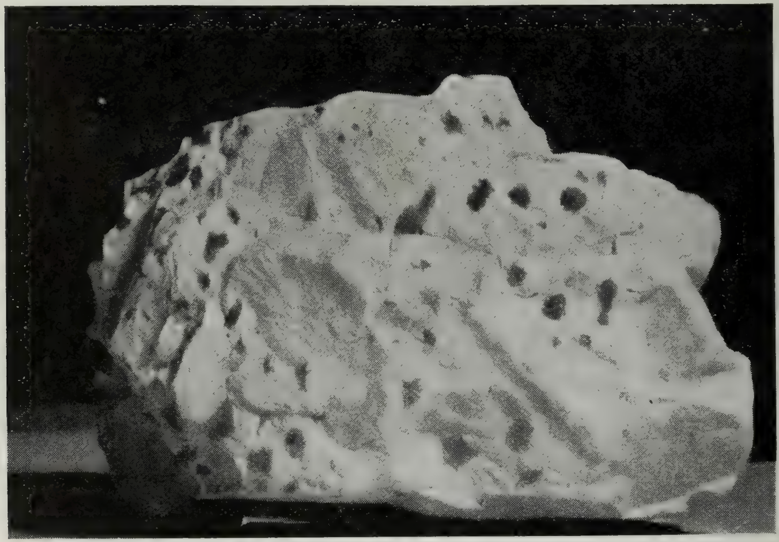

FIG. 8. Nonplastic "Bone" clay, showing angular, irregular spaced segregations of darker ferruginous material in the bone portions of the clay bed lying below the coal stratum. A possible derivation of these particles is to be seen in Fig. 10.

4. *Bone-Clay or SH4 Clay.* The coal is underlain by a four-foot clay bed high in alumina, which, when not pisolitic, is a plastic clay used as a ball or refractory bond material; but when pisolitic, is non-plastic and is termed 'bone.' Its peculiar texture may vary from a few sparsely distributed angular-shaped oolites to round pisolites.

A microscopic thin-section of the plastic material, locally termed SH4, reveals that practically all of the materials in the clay are isotropic or nearly so. The mass is so extremely fine-grained that even in the largest grains distinction and identification is very difficult. A small amount of hydromica and chlorite was seen. Estimated mineral percentage is as follows: halloysite group 85%, quartz 3%, carbon 10% and hydromica 2%. Apatite, zircon and rutile also appear in this section.

A thin section of the bone-clay which was less plastic than the SH4, but more plastic than some varieties of bone, shows about the same birefringence as the plastic clay. However, a very weakly anisotropic mineral is present which has about the right amount of birefringence for a mineral of the kaolin group. The pisolites seem to be composed of rings of ferruginous material, but do not appear to be gibbsite, although they might contain bauxite, which absorbs iron stain readily. Estimated mineral percentage is as follows: halloysite group 80%, kaolin group 5%, 'limonite' 5%, quartz 3%, hydromica 2% and carbon 5%.

The concentric structure of the 'bone' type of clay in common geological usage indicates the presence of alumina hydrate minerals. This criterion, however, is apparently not diagnostic and should be applied with some caution, although only the high alumnia clays of this district are pisolitic.

The uses of this type of clay have already been discussed in the classification of clays. In general clay that is called 'soft bone' is ground and used in refractory wares, the 'hard bone' is calcined and incorporated as 'grog' in the same materials. Clays of the SH4 type are used as refractory-bond, or even-ball clays.

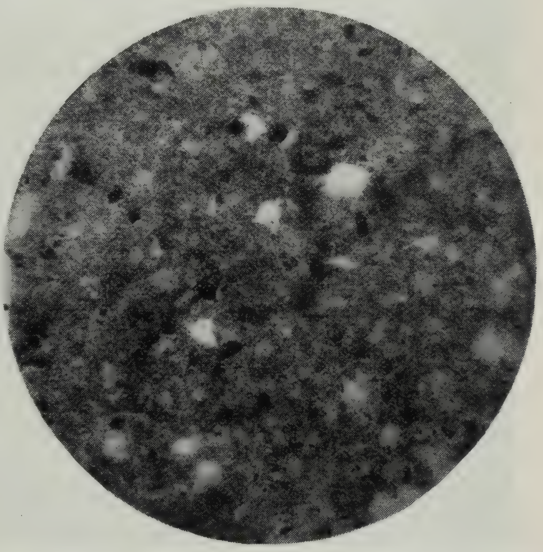

FIG. 9. Photomicrograph of "Bone" clay. The larger white patches are quartz, the dark are hydrous iron oxide. Taken with ordinary light, magn. 100 x diam.

5. Red-burning Clays. At Alberhill, the above section is usually floored by an irregular thickness of red-burning clays, some of which consist of altered phyllite schists of the basement complex, but the major portion of which are badly stained sedimentary clays. The more plastic of these residual clays are used in many types of low-vitrification wares, while the less plastic are usually cast aside. All of the red-burning clays in this area, whether transported or residual, have to compete with the more accessible clays of the Los Angeles district, all of which are of this type. As their principal market is in the Los Angeles area, transportation of them either in the raw or burned state has been one of their biggest commercial handicaps. Of late years, however, the rapid depletion of the better grades of raw materials near Los Angeles and the increase of the general quality of clay wares, have caused the Orange and Riverside County tracts to contribute more and more tonnage of this type.

Other Deposits.

Within the Alberhill district should also be included the several clay pits lying immediately across the valley. In the No. 23 and the old Sloane pits, the clays are similar in ceramic properties and geologic characteristics to the Alberhill Main Pit clays, and probably represent the same sedimentary horizon. Stratigraphically below them occur a series of argillaceous beds which are best exposed in the Pink Mottle, or No. 1 pit of the Los Angeles Brick Company. Here, a small thickness of alluvial stripping is unconformably separated from the clay beds below consisting of white 'bone' clay, below which occurs an irregularly iron-stained clay bed locally termed 'Pink Mottle,' followed by a very ferruginous red plastic clay, which is in turn underlain by a white-burning clay followed by a great thickness of arenaceous red-burning material.

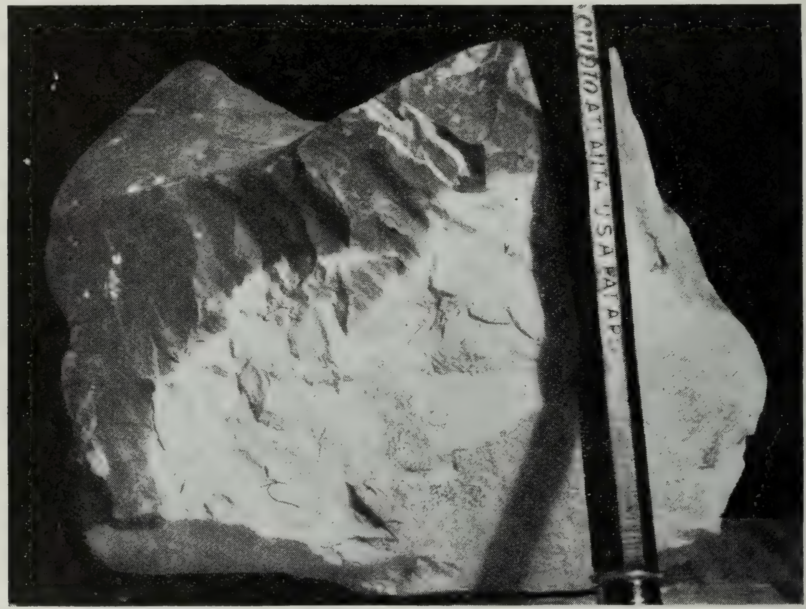

FIG. 10. "Pink Mottle" blocky clay. The dark portions of the hand specimen are red stained by hydrous iron oxide, the light is cream colored. This is an extreme plastic red burning low vitrification point clay, widely used in sewer pipe and similar mixtures. Natural size.

Within this pit, the purer clay of the Pink Mottle bed grades into an altered conglomerate along the strike. The pebbles and granules show a preponderance in rhyolitic material. Quartzites, schists, and a variety of other rocks are present in minor quantities. Considerable quartz sand is present which is quite angular in form. The granules of the material vary in form from angular to well-rounded, but for the most part, they are sub-angular. This conglomerate is regarded as an alluvial deposit. The large percentage of the rhyolite within the unaltered rock and its water-worn character would indicate a nearby acid lava flow. The variation from plastic clay to an almost unaltered conglomerate, with the rhyolitic pebbles still glassy and hard, was found to be sharp in most instances. Inclusions of altered conglomerate were found in the clay portion of the bed. In thin section, the clay variation of the Pink Mottle bed, when studied under the petrographic microscope, is seen to be composed of coarse, rounded 'ghost' pebbles, in which, however, but few of the original igneous textures can be seen. Estimated mineral percentage is as follows: Quartz 50%, montmorillonite-beidellite group 30%, colloidal iron 15%, halloysite 5%.

The clays of the *Harrington* pit, in the upper end of the valley, and lying on top of the Perris fault block, are very closely akin to those of the Pink Mottle pit, and undoubtedly represent the same stratigraphic horizon. The same succession is present, that is: bone, pink mottle, highly ferruginous plastic, white-burning plastic, and a huge thickness of arenaceous red-burning clay which in turn overlies the schists of the basement complex. The same irregular alteration of the rhyolite conglomerate to bentonitic clay is also well illustrated here, the field relations being exactly similar to the Pink Mottle pit to the south.

South of the Harrington pit, clays are also exposed near *Twin Springs* Service Station. The clay horizon has been carried up to the surface on the northern flank of the synclinal structure, here warped by a transverse anticline. Exposures in the vicinity are poor, practically all of the area being covered by alluvial detritus which is occasionally cut through by the rejuvenated streams running out of the canyon of the Santa Ana Range. The clays occur in the bottom of one of these canyons and consist of two types: (1) a fine-grained, extremely plastic clay which is classed as refractory bond; (2) a red-mottled semi-to non-plastic clay, in some places extremely pistolitic, the entire mass being composed of very well rounded oolites. Under the microscope thin sections of this material do not appear to contain gibbsite or diaspore hydrate minerals, but is for the most part composed of an isotropic mineral which may be bauxite or of the halloysite group, with consider-

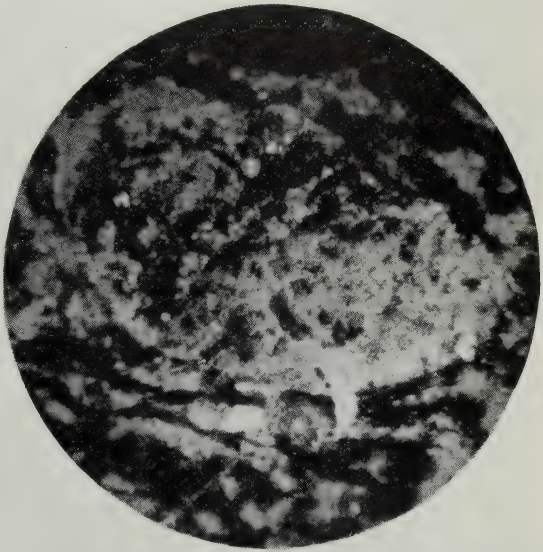

FIG. 11. Photomicrograph of "Pink Mottle" clay showing residual structures. The rounded lighter portion represents a completely altered particle which was originally laid down as a granule of rhyolite and since then has been completely altered by secondary changes. Picture taken with ordinary light, magn. 19 x diam.

able amounts of 'limonite' occurring as dark concentric rings surrounding the pistolites, as staining and replacement.

The only pit south of the town of Elsinore which regularly produces clays, so far as the writer knows, is a small mine called the *Wildomar Kaolin* deposit. Its importance in this discussion lies in the fact that the clays are residual in origin. This deposit lies 2.6 miles southwest of Wildomar on the main highway to Murrieta, and is only one of several outcrops.

At this place, the beds strike N. 37° W. and dip 26° to the south. They plunge under the alluvium of the valley, but were not observed coming up on the other side. These beds lap up on the foothills on the eastern side of the valley, and are terminated by a fault which separates the bentonite beds from the basement complex of the hills to the east. The clays are clearly derived from acid-lava flows, which have been altered in place to their present condition. Beds consisting of altered rhyolites and rhyliotic tuffs, pumiceous and agglomeratic, make up the section. The beds break very easily along the bedding planes of the flows and also along lines of flow-structure. Advantage is taken in mining of that fact. While this material has been very considerably altered from its original condition, divitrification and alteration has not proceeded nearly so far as in the case of the Pink Mottle bed.

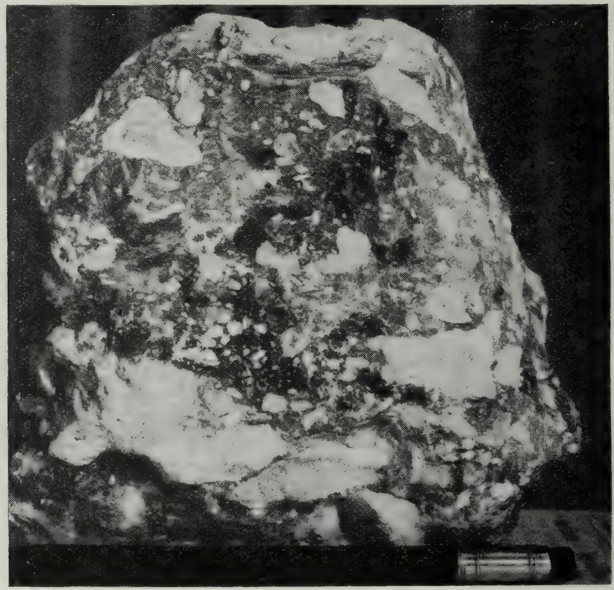

FIG. 12. "Pink Mottle" clay from Harrington pit. This material is a partially altered rhyolite-conglomerate, the pebbles of which in some portions of the bed are still vitrified and glassy, in other portions are altered to clay and in still others have lost all individual characteristics from the matrix and present an even blocky appearance. One-half natural size.

A thin section of this material, taken across the flow structure, shows under the microscope characteristic rhyolitic texture, such as

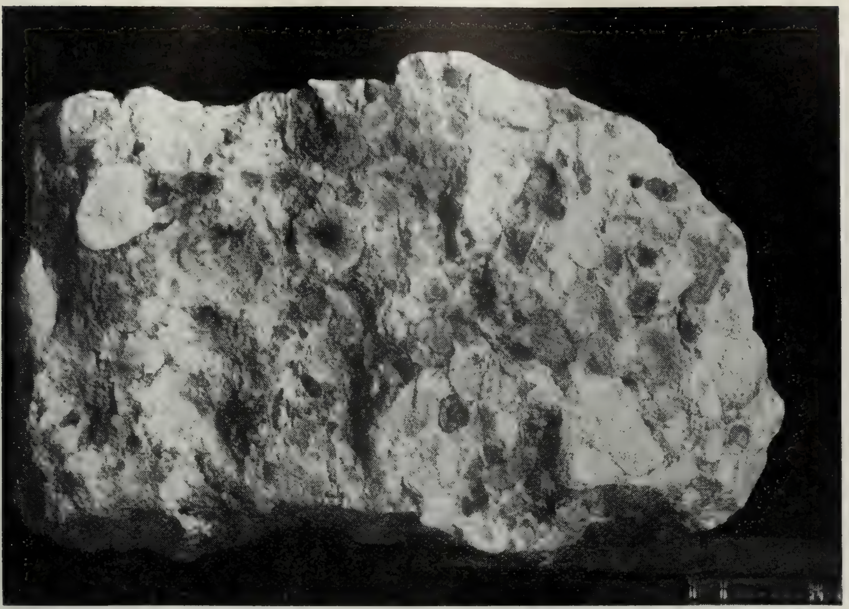

FIG. 13. Hand specimen of material from same bed as of Fig. 10, showing possible derivation of angular pisolites in some bone clays of district. In the upper left center of photograph, a concentration of the ferruginous material within one of the former rhyolite pebbles has given rise to an angular pisolite. Persistence of these features, however, through complete alteration of the conglomerate to the type of clay as in Fig. 12 was not seen.

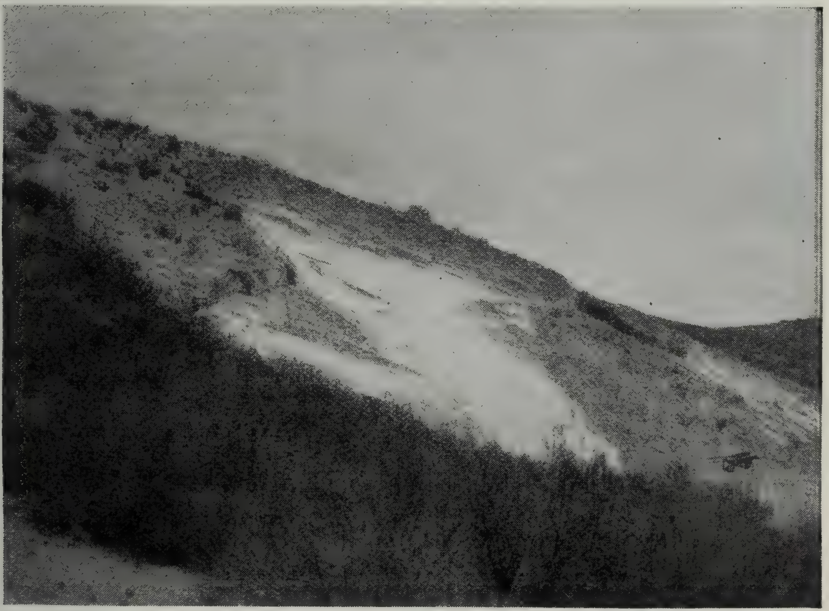

FIG. 14. Wildomar pit towards the southeast, showing remarkably well developed parting within the successive volcanic flows.

stringers of glass, portions of bubbles and a few phenocrysts. With polarized light, only corroded and somewhat oriented quartz phenocrysts can be observed, the matrix being isotropic glass. The extremely acid nature of the rock is shown by the presence of this type of phenocrysts, and by following ultimate chemical analysis from the laboratory records of the Pacific Clay Products of Los Angeles:

	Wildomar Clay Per Cent
Ignition loss	7.78
SiO_2	70.14
Al_2O_3	14.97
Fe_2O_3	1.61
CaO	1.58
MgO	.09
Alkalies	3.94

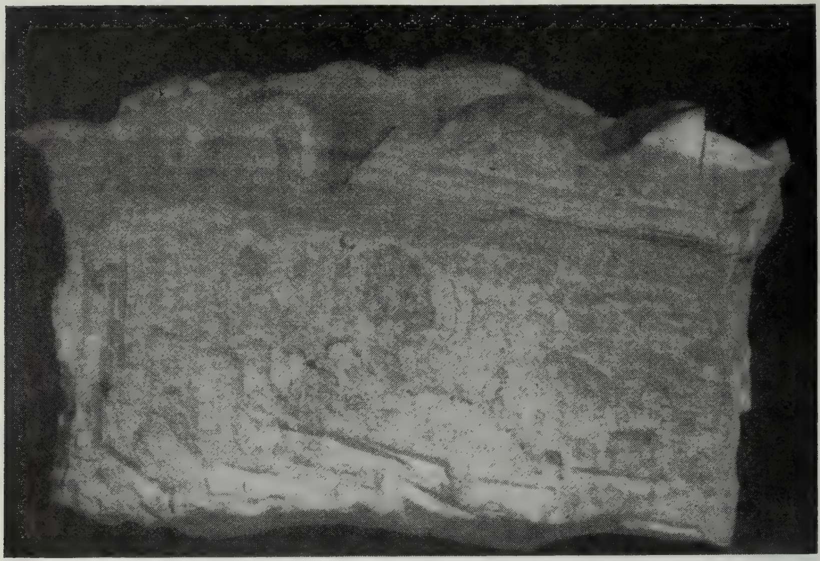

FIG. 15. Hand specimen of Wildomar clay, showing agglomerate and the finer, cooling cracked, more glassy portion of the base of the next flow at the top of the photograph. Natural size.

The comparative lack of alteration of the material is brought out by its high alkali content. It is even better shown in the results of computation by the H. S. Washington method of obtaining the theoretical mineralogical content of clay from the ultimate analysis, given as follows:

	Wildomar Clay Per Cent
Quartz	42.48
Kaolinite	19.7
Limonite	2.16
Serpentine	2.21
Orthoclase	23.2
Anorthite	7.9
Free water	4.7

The clay is non-plastic and is used as a filler in various mixtures, particularly in stoneware. It burns to a brown color at a rather low temperature but possesses a very low shrinkage. Considerable quantities of this material have been mined by stripping and hand-loading methods and also by a shaft sunk to follow the bed beneath the valley floor.

Residual clays are found at a commercially unimportant but a scientifically interesting deposit immediately across the canyon northeast of the Douglass pit at Alberhill. They represent alteration of hypabyssal quartz-latite porphyry which intruded the metamporphics of the basement complex. Subsequent alteration of the igneous rock has been so profound as to make this clay intermediate in decomposition between the residual clays of the Wildomar pit and the softer portions of the Pink Mottle bed of the Pink Mottle and the Harrington pits. These residual clays, all of which unquestionably represent alteration in place, exhibit three stages of progressive alteration, just as the same variation is found within the above mentioned Pink Mottle bed.

McKNIGHT—CORONA CLAYS

Local Geology.

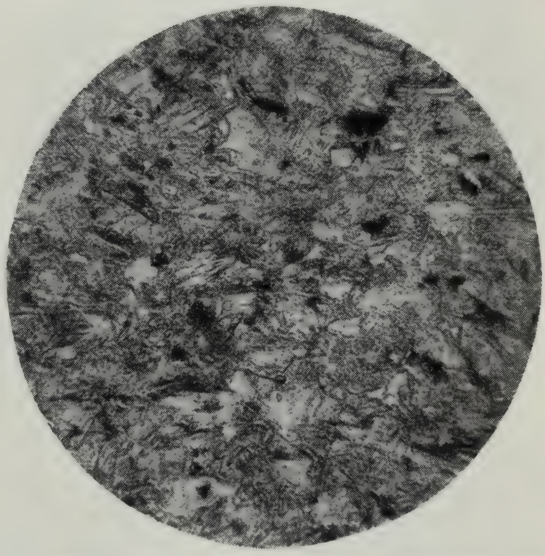

FIG. 16. Photomicrograph of Wildomar clay showing remarkably well developed tuffaceous structures, such as stringers of glass, broken shells of bubbles, etc. Taken with ordinary light, magn. 100 x diam.

The elongated triangle which lies between the Chino fault, the Whittier fault and the Santa Ana Canyon, is very complicated structurally and increased in complexity towards the apex of the triangle on the south, where the Chino and Whittier faults merge and join into the Elsinore fault. The trace of the Whittier fault bounds the south side of the Puente Hills, crosses Santa Ana Canyon, turns southeastward, and continues along the boundary of the main block of the range as the Elsinore fault. The Chino fault, the existence of which has been the subject of considerable discussion among geologists, also bounds the Puente Hills, but on the eastern side, and continues southward, bounding the foothills to the south of the Santa Ana River, and eventually joining the Whittier-Elsinore fracture-zone.

Both of these fault systems are primarily reverse faults in character and indicate a considerable shortening of the earth's crust. Compressional forces, producing thrust movements along reverse-faults in sediments, normally result in folding and faulting structures in either the lower or upper block which parallels the zone of fracture. Examination of the folds and faults of the triangular block together with its continuation, the Puente Hills, shows that those structures which give evidence of shortening are, in general, perpendicular to the axis or bisectrix of the Y thus produced. This fact would seem to indicate that the Chino-Corona and the Santa Ana Range blocks moved northward with respect to the Puente Hills, although a drag in the folds in the vicinity of the Chino fault block indicates that there may have been differential horizontal movement corresponding to the displacement of the San Andreas rift. Thus the Puente Hills block may be acting as an incompetent mass between competent east-west blocks bounding the north side of the Los Angeles Basin and the blocks to the south.

The steep rise of the land surface from the head of the alluvial fans above the Corona plain to Sierra Peak appears to be due to a series of step-faults. Four main step-blocks may be distinguished, and each of the four blocks is topped by successively older formations, according to their position relative to the core of the range. On the bottom block, which is separated from the alluvial-covered block by a fault, lie sandstones, shale, and conglomerate beds of Martinez age. They are separated from the Cretaceous sandstones and shales of the next block by a fault-scarp. These Cretaceous sediments of the second step abut the granodiorites and metamorphics of the basement complex in fault contact on their western side. To the west of this belt of crystalline rocks, the Cretaceous beds again outcrop, the relationships being a depositional contact. These sediments have a fairly strong westward dip and in turn are faulted against the crystalline rocks of the crest of the range.

In addition to the northwest-southeast fracture-zones, the steps are further cut by innumerable cross faults which are roughly perpendicular to the major structure. These cross-fractures are predominantly reverse in character, frequently having dips as low as 20° or less. While the movement along the individual zones of slippage is small, the total shortening would aggregate many feet.

The axes of the folds of the sediments in the triangle also trend northeast-southwest. The clays lie between relatively competent beds of sandstone and conglomerate and form a very favorable plane of slippage, along which major and minor movements have taken place when the attitude of the beds was favorable. At the McKnight mine, for instance, just south of Tin Mine Canyon, the sedimentary series strike N 65° E and dip 25° to the south. This attitude has apparently placed the clay bed in a position favorable for thrust-slippage, for it has suffered considerably.

The McKnight clay beds are intercalated in the sandstones and conglomerates of the Martinez formation which is exposed in the first step-fault block. The clay beds represent the end product of a process of deposition of increasingly fine material and grade downward in the section to arkosic sandstones which in turn pass into coarser and coarser conglomerates. These conglomerates are composed of well-rounded pebbles of quartzites, fine-grained intrusive rocks, intermediate in composition, schists, and infrequently older re-worked conglomerates, sandstones, and shales. The matrix is a coarse, arkosic sandstone containing considerable amounts of chlorite, biotite and muscovite. The conglomerates grade into sandstones and shales above, the mineral content remaining about the same. There is no doubt that a considerable portion of these materials were derived from Cretaceous sediments, and that their source was not far away.

Above the shales and clays lie massive sandstones in which a Martinez Eocene invertebrate fauna was found, including such forms as giant *Venericardia* and *Turritella pachecoensis* Stanton. These fossils were found almost immediately above the clay horizon.

Description of the Clays.

As previously indicated, the clays lie in a more or less plastic zone, and the transition from sandstone to clay to sandstone is not abrupt. The sandstones below are green or buff, but as they approach the clays, they become darker in color, passing into shades of gray. The clay bed is overlain by shales which are universally stained red or pink by iron-oxide, in part deposited with the sediments or derived from the immediate beds mainly leached from the overlying sediments and deposited on top of the impermeable layer of clays. These stained shales were used in the past as red-burning low-vitrification clays, because they were sufficiently argillaceous. They are, however, no longer exploited.

The major portion of the clay stratum is composed of a flint fire-clay, more or less sandy and well-indurated, which contains a variable amount of gray or black finely disseminated carbon. In places the carbonaceous material is concentrated in lenses and pockets of coal, in which occasional lenses of pisolitic bone-clay may be found. In other places, very little carbon is present, and lenticular bodies of an extremely hard light-gray fire-clay may occur with or without the regular black fire-clay. The white or light-gray clays lack the toughness of the darker portions of the bed, contain considerablely less quartz sand and break, when exposed to the air, with conchoidal fracture.

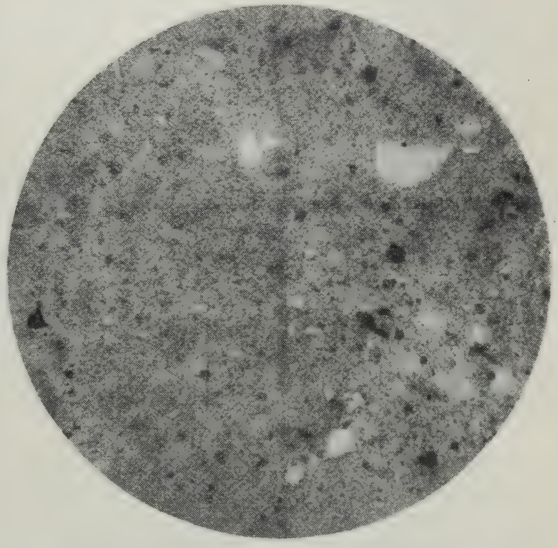

FIG. 17. Photomicrograph of the McKnight flint fire clay showing its texture. Taken with ordinary light, magn. 100 x diam.

Under the binocular miscoscope, the coarse sand is seen to be made up almost entirely of clear, well-rounded quartz, and infrequent, badly altered feldspar minerals. Heavy minerals found, in order of frequency, include the following:

1. Ilmenite, frequently showing traces of rhombohedral forms.
2. Magnetite, silver gray in color.
3. Tourmaline, light brown, but only slightly pleochroic.
4. Sphalerite (?) with good cleavage, black, opaque, and resinous.

A thin section of a specimen of fire-clay, when examined under the petrographic microscope, showed an extremely fine-grained material, with the larger particles of quartz making up about 30% of the slide. Estimated mineral percentage of the matrix is as follows: kaolin group 35%, montmorillonite-beidellite group 30%, halloysite group 4% and chlorite about 1%.

The following analyses were obtained from the Pacific Clay Products, who own and operate the McKnight Mine:

	Black McKnight fire-clay Per cent	Red McKnight red-burning Per cent
Ignition loss	10.62	8.73
SiO_2	57.38	63.86
Al_2O_3	27.62	21.52
Fe_2O_3	2.06	4.12
CaO	1.90	.24
MgO	.11	.09
Alkalies	.13	.83

Calculation by the H. S. Washington method of the mineral content, ignition loss set aside, gives the clay the following theoretical composition:

	Black McKnight fire-clay Per cent	Red McKnight red-burning Per cent
Quartz	23.2	33.15
Kaolinite	60.10	52.50
Serpentine	2.50	.19
Limonite	2.43	4.20
Albite	1.25	7.20
Anorthite	9.45	1.20
Free-water	1.7	.70

On account of the predominance of plagioclase in the original rocks of the basement complex, from which this clay was derived and later deposited under transitional to shallow marine conditions, the alkali content has been calculated as soda.

The fire-clay has a fair plasticity, a medium low-dry strength and is granular and friable when dry. Steel hardness is developed only at a very high temperature. The softening point is cone 33 (1745° C.). It has a low shrinkage due to the amount of sand contained in it. It possesses excellent hand-moulding qualities and is largely used for that purpose.

The Red McKnight Red-burning clay was formerly used as an ingredient in sewer pipe and brick mixtures. It has a better plasticity than the fire-clay although it is weakened by the large amount of sand. Fingernail-hardness develops at cone 010 and steel hardness at cone 7. It has not been mined for a number of years, the previous large production ceasing when the clay products plant at Corona burned down.

The McKnight mine is one of the oldest clay-producing properties in southern California, operations having begun as early as 1890. Most of the mining is carried on underground, overhead stoping methods being employed. Minor faulting has so broken up the fire-clay stratum that the spur in which the mine is located is literally honey-combed by the tunnels and raises driven into it by the exploiters in an effort to find and extract the clays.

GOAT RANCH OR CLAYMONT CLAYS

Local Geology.

A valuable deposit of clay is mined on the northern tip of the Santa Ana Range by the Gladding McBean Company, and the property is known as the Goat Ranch or Claymont mine. Clays in the vicinity of Goat Ranch have been mapped by English[20] as Cretaceous, therefore subsequent writers have assumed that all of the clays belong to that geological period. English, however, may have referred to some long-since abandoned pits, for the clays now mined belong to an entirely different geological formation. Stratigraphic relationships of the horizons now producing, indicate that these clays are Martinez Eocene in age, and not earlier. The lignitic shales in which the flint fire-clay bed is intercalated, grade downward into a coarse sandstone unconformably deposited over the Cretaceous, Chico, series. The Chico here exposed consists of a bed of coarse conglomerate overlying a finely laminated reddish-black shale, aggregating at least 1000 feet in thickness. The actual contact of coarse sandstone with the conglomerate was not examined, but the attitudes of the underlying conglomerates appear to have a slightly greater dip in the vicinity of the mine. Although no diagnostic fossils were found in either the upper or lower member, there is no doubt that the shales are Cretaceous in age, for the middle portion of that formation, to which the shales belong, is unique in its lithologic character. The material above the conglomerates, on the other hand, strongly resembles the Martinez of the Santa Ana Mountains.

The basal conglomerate, although coarser, of the Martinez formation as exposed in Silverado Canyon, is exactly like the coarse sandstone in general appearance and induration, and an analogous bed in the Cretaceous is not to be found. The shale and sandstone pebbles included in the conglomerate are similar in the two localities, and the assemblage of materials differ only in proportion, the bed at Silverado Canyon having the more sedimentary pebbles. It also possesses a striking resemblance to the conglomerate which underlies the McKnight fire-clay.

English[21] states that the presence of glauconite is characteristic of the Martinez of the northern end of the Santa Ana Mountains. The present investigation revealed no glauconite, but instead a large amount of chlorite, which, when abundant seems to be confined to the Martinez of the entire Santa Ana Mountains.

The classification of the age of the clays as Martinez Eocene, rather than Cretaceous, as they have heretofore been considered, is further strengthened by the remarkable similarity in manner of occurrence, mineral assemblage, and in ceramic properties between the Corona-McKnight and the Goat Ranch clays, and also due to the presence of *ostrea* beds towards the middle of the section which resembles the beds near Twin Springs.

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[20] English, W. A., Geology and oil resources of the Puente Hills, Southern California: U. S. Geol. Surv., Bull. 768, 1926.

[21] English, W. A., *Op. Cit.*, p. 12.

If this assumption is true, a strong unconformity should exist below the conglomerate member. A normal section of the Cretaceous of the northern Santa Ana Mountains shows that the formation is composed of three broad members as follows: (1) a top layer of sandstones and conglomerate which is about 700 feet thick; (2) a section of dark-colored finely laminated shales, about 1500 feet thick; and (3) another layer of sandstones and conglomerates, which aggregate about 800 feet in thickness. Inasmuch as the greater part of the top sandstone member is completely missing, a hiatus is indicated sufficient for uplift and erosion of at least 600 feet of material.

A northerly-dipping monocline forms the principal structure in the central portion of the extreme northern end of the Santa Ana Range, in which the Cretaceous and Martinez sediments dip steeply away from the basement complex of the range. In the vicinity of the Goat Ranch, the beds nearly parallel the long surface which runs down toward the Santa Ana River. On the south end of the Claymont property a hard resistant bed of flint fire-clay forms the capping of the hills extending from Sierra Peak toward Santa Ana Canyon. The dip of the beds take them below the surface at a variable distance from the west line.

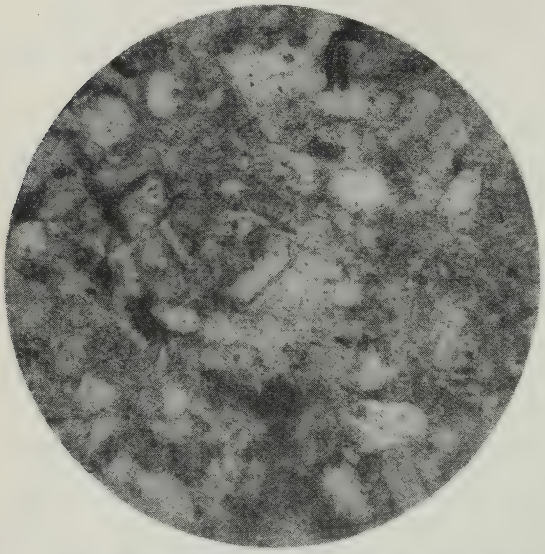

FIG. 18. Photomicrograph of the Goat Ranch flint fire clay, showing comparatively coarse texture. The fibrous chlorite at upper edge may be clinochlorite. Taken with ordinary light, magn. 100 x diam.

Description of the Clays.

Of the two types of clay which occur on the property, the flint fire-clay or marine clay which is mined by tunnel in the canyon is by far the most valuable. It is a persistent bed of hard black clay containing considerable amounts of carbon and lies stratigraphically above the lighter colored clay exposed on the edge. Like the McKnight clay bed, it represents the end-product of a process of deposition of increasingly finer material. Its average thickness varies from four to seven feet. Lignitic coal lenses occur above the clay bed, which occasionally itself takes on a lignitic character. On top of the ridge, however, the clay contains practically no carbon and is light-gray in color. Quartz sand is disseminated throughout the clay and is also concentrated in lenses, which in places contain too large a proportion of it to be valuable.

Below is found an extremely pisolitic 'bone' clay, which has apparently not been mined.

A thin-section of a specimen of the flint fire-clay from the top of the ridge shows under the microscope that it is composed of about 45% quartz, 40% kaolin group minerals, 12% chlorite and 3% minerals of the halloysite group. The grains of quartz are by far the largest of the minerals in the section. The chlorite, which is light-brown and pleochroic, is in the form of long thin-fibrous masses, with a birefringence of about .015.

The clays of this deposit are used for the same purposes as those of the McKnight-Corona. Since they have a high fusion temperature (cone 34 or 1755° C.), they are principally used in making high-refractory fire-brick. Some of the shales which burn red and vitrify at a low temperature by reason of their high iron content have been used for common brick and tile but they can not now be mined in competition with the more easily accessible and better clays of Temescal Valley. In mining the fire-clay bed, the Gladding-McBean Company, who operate the property, run tunnels up the dip of the bed from the head of the canyon, tram the clay to chutes which carry the material to loading bunkers at the canyon bottom. Practically all of the clays are used at the Alberhill plant of the company. No figures on the yearly tonnage mined have been secured.

SERRANO OR EL TORO CLAYS

The Serrano clay bed outcrops along the west-central portion of the Santa Ana Mountains from Trabuco to Silverado Creeks, just east of the Modjeska Road. The nearest town is El Toro, which lies 10 to 15 miles from the various mines. Since the principal producing mine is on the Serrano Ranch, the clays herein described may be called the Serrano, or El Toro clays.

Local Geology.

The sandstones in which the Serrano beds are intercalated have been mapped as Vaqueros Miocene by previous workers[22] in the field. In the course of the present investigation, however, it was found that the formation more closely resembled the Martinez in the other portions of the Santa Ana Range. The abundance of chlorite and the induration of the material were notable criteria which did not agree with the definitely known Vaqueros formations. In the course of mapping the areal extent of the bed, both Dr. Bernard Moore, who also worked in the area, and the writer traced the clays with only one short break in continuity, into a series of beds which were established as Martinez on the basis of an invertebrate funa found very close to the clay exposure in Silverado Canyon.

The Martinez formation of the Santa Ana Mountains is, in the main, made up of massive sandstones which when fresh are white or green, depending upon the amount of chlorite present, but which upon weathering become a uniform buff. These sandstones overlie a basal bed of conglomerate. The conglomerate bed in Silverado Canyon is

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[22] Dickerson, R. E., The Martinez and Tejon Eocene and associated formations of the Santa Ana Mountains: U. of Cal. Pub. Geol., vol. 8, No. 11, 1914.

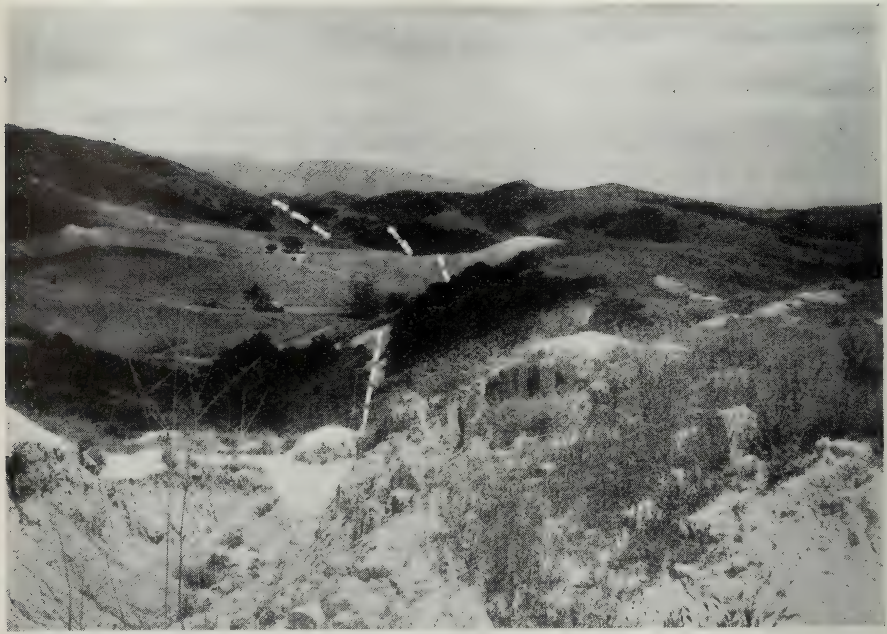


FIG. 19. Outcrop of the Serrano clay bed looking southeast from the top pit of the Serrano mine. The heavy white line denotes the surface intersection of the clay bed which lies within the Martinez formation. The comparatively gentle western slope of the Santa Ana tilted block is evident. *Photo by B. N. Moore.*

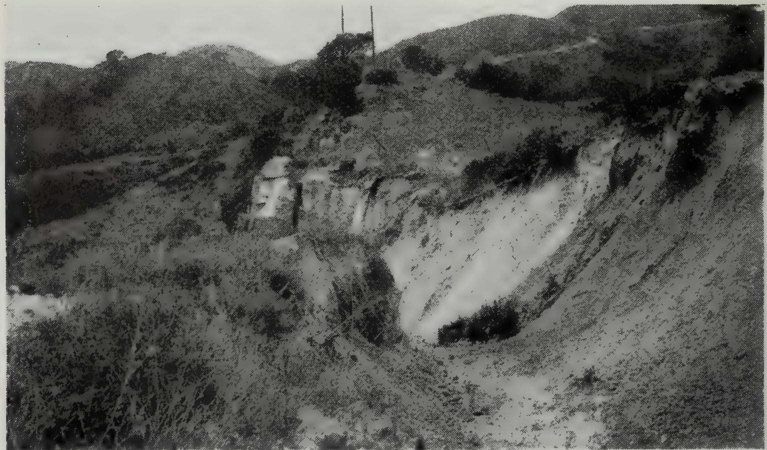


FIG. 20. Close-up of the Serrano pit looking in the opposite direction. The beds at this point are almost vertical. Dark green shale lies at the base of the bed to the right and a localy resistant bed of buff sandstone overlies the clay stratum. Modjeska grade is in the distance.

made up of pebbles of quartzite, dacite, slate, shale, and sandstones, which have apparently been largely derived from the sandstones, shales, and conglomerates of the Cretaceous, and this character is typical of the bed wherever it was observed. The pebbles average one to two inches in diameter and the harder materials are well-rounded. The matrix is an arkosic sand in which considerable amounts of chlorite are present.

Description of the Clays.

The clay bed constitutes an easily mappable unit and can readily be distinguished from the remainder of the Martinez by reason of its plasticity, white or pink color, and the ease of erosion in contrast to the harder buff sandstones. The bed was readily traced for almost eight miles, its outcrop being almost a continuous line and only broken by minor faulting. The largest displacement seen occurs along a northwest-southeast fault which runs through the divide just north of the Serrano mine. The beds in this vicinity have a dip of 75° to the south and a strike of N. 65° W. The fault plane is very close to vertical and has a strike of N. 75° W. Apparently the existing field relations were brought about by vertical movement along the fault with the northeast block relatively rising with respect to the other block. This was followed by erosion to the present level.

The clay bed lies about 2200 feet above the base of the Martinez at Trabuco Creek, about 200 feet above at the Santiago-Aliso divide, and about 250 feet above in Silverado Canyon, and is here 150 feet above a series of lignitic shales and clays which are believed to represent nearly the same horizon as the Goat Ranch materials. Although the clay beds of these two localities may not be continuous nor of exactly the same horizon, they certainly approach each other closely in the stratigraphic series and were laid down under similar conditions.

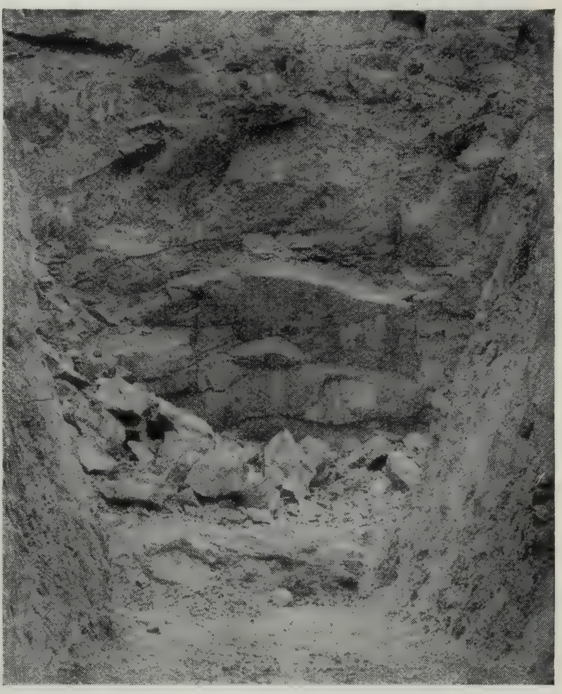


FIG. 21. Bottom pit at Serrano mine, showing massive, blocky character of the clay bed, which dips 75° away from the observer. The contact between the Serrano clay and the underlying green shale can be seen on either side of the truck-way, at the sides of the picture. In mining practice, the lower portion of the face is blasted out and the upper portion of the cliff is then caved.

The main mass of the bed of fine, white sandstone of which the clay bed forms the base, contains little alteration products and is composed mainly of quartz. A sharp increase in the amount of clay in the matrix of the sandstones may be detected at the upper contact of the clay bed. Immediately below the bed lies a fine-grained dark-green chloritic shale, which, when weathered, is dark-red. It overlies lenses of lignitic shales which vary widely in size and content of carbonaceous material. In Silverado Canyon is a coal lens of sufficient purity that the Southern Pacific Railway once mined it before the discovery of oil. This coal outcrop was considered as Cretaceous by Dickerson and others but is here more correctly assigned to the Martinez. A sharp contact exists between the green shale and the overlying clay bed, and only small amounts of chlorite are found within the clay bed itself.

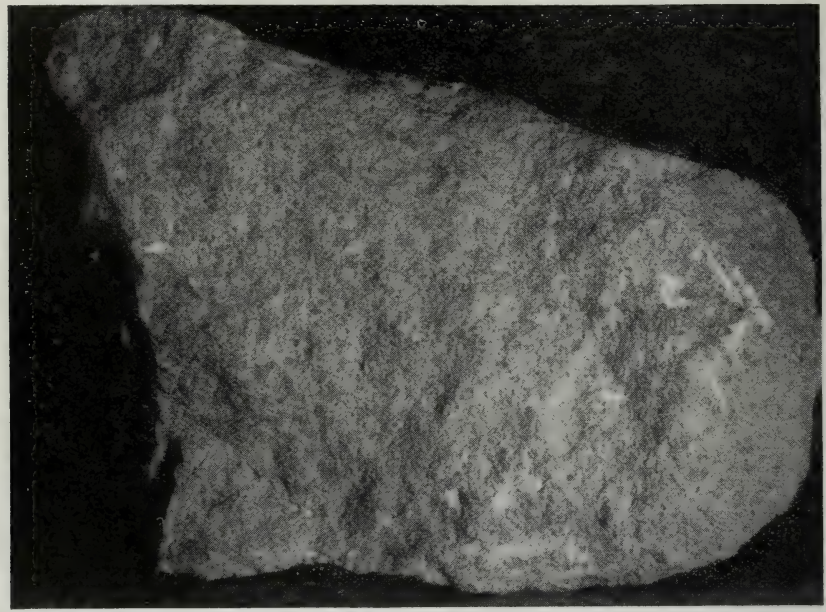


Fig. 22. Hand specimen of Serrano clay, illustrating ccomparatively coarse sand particles irregularly embedded in the matrix of fine clay. Natural size.

Almost universally the upper portion of the clay stratum is stained various shades of pink or red, the iron-oxide having apparently been derived from the sandstones above. The main part of the clay bed is usually gray-white, but, with inclusions of carbonaceous material, or ferric oxide, it may vary widely in color along the strike.

The remarkable continuity of the clay horizon, and its sharp differentiation from the sediments in which it is intercalated, indicate a sudden and temporary change in the materials laid down during that portion of Martinez time. The original material of the bed is considered to have been deposited as an altered arkose because of the irregularly scattered sand particles in the clay matrix, and to have been further altered to its present state since deposition. The field relationships suggest that the clays are in part bentonitic, and that a portion of the materials whose decomposition products gave rise to the clays is volcanic in origin, so that this horizon may be a near correlative of the Alberhill ceramic materials. Microscopic examination, however, fails to reveal any positive criteria tending to prove such a derivation, although a few features are suggestive.

The material of the bed consists of grains of slightly impure sand, imbedded in a matrix of hydrous oxides and silicates of iron and alumina. Microscopic examination shows the coarse particles to be clear quartz, which is rounded, subangular, or infrequently, angular. Altered feldspar grains are also present in minor quantities and are too much kaolinized for exact determination. Chlorite, and in minor amounts, biotite and muscovite, were also found. Heavy minerals present, in order of frequency, are: ilmenite, in irregular grains partially pocketed and coated by leucoxene; tourmaline, yellowish irregular grains and prisms; staurolite, in light brown irregular grains; magnetite, somewhat altered; almandite, light brown, irregular in shape; and pyrite, badly altered but frequently with some suggestion of isometric form.

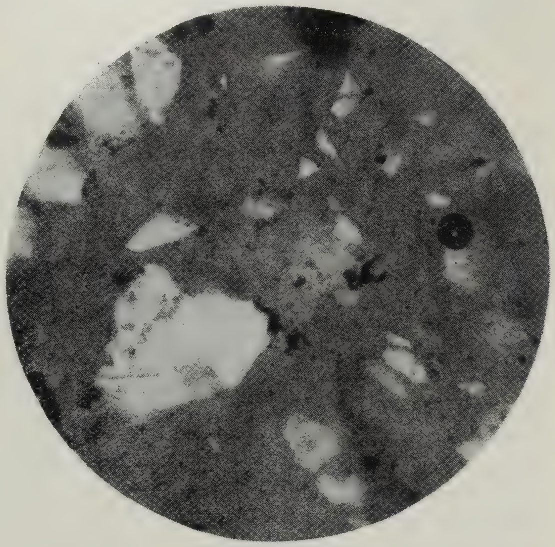


FIG. 23. Photomicrograph of Serrano clay, showing texture, and the relation of the quartz to its matrix. Taken with ordinary light, magn. 100 x diam.

Thin-sections of the Serrano clay show under the microscope that there is a large discrepancy between the sand portions and their extremely fine matrix. The material is composed of about 55% quartz, 25% montmorillonite-beidellite, 15% halloysite group and 5% chlorite. One or two structures were found which would suggest a partial tuffaceous origin, although they were not clear enough to positively identify the material as such.

The following chemical analyses were obtained from the laboratory records of the Pacific Clay Products of Los Angeles, who operate the Serrano mine:

	Serrano Plastic Per cent	Serrano Average Per cent	Serrano Washed Per cent
Ignition loss	11.57	8.42	14.02
SiO_2	54.08	65.94	47.44
Al_2O_3	30.00	22.65	36.06
Fe_2O_3	2.57	1.41	2.40
CaO	.26	.10	None
MgO	.45	.26	None
Alkalies	.23	.21	.14

The analysis of Serrano Plastic was of a specimen selected from a lens containing more clay and less quartz than the average. Serrano Average is the ordinary run of the mine material. Serrano Washed is the clay after most of the quartz has been removed by washing.

Computation of the minerals of the clay from the ultimate analyses by the H. S. Washington method gives the following:

	Serrano Plastic Per cent	Serrano Average Per cent	Serrano Washed Per cent
Quartz	18.00	38.40	4.83
Kaolinite	73.1	59.1	90.5
Serpentine	1.0	.57	None
Limonite	3.0	1.68	2.9
Albite	1.25	1.12	.77
Anorthite	4.19	1.05	None
Free water	.60	.23	1.3

A variable portion of the bed is stained by iron-oxide solution, usually consituting the upper third to half of the clay stratum. When iron-oxide is contained in sufficient amounts visibly to stain the clay, it lowers the fusion point and colors the burned ware, so that the material can only be used for cheaper products. Thus little of this clay is used.

The white clays are used in face-brick and low-grade fire-brick mixtures. When washed, they may be used for china clays and slip clays, although but little material has ever been employed in these capacities owing to the cost of preparation. Partially washed and ground, they can be and are used for white stoneware products. The natural clay burns buff at cone 10 (1260° C.) and has a moderate shrinkage at that temperature. The washed clay burns white at a high temperature, but becomes darker when cone 20 to 26 (1530–1595° C.) is reached. As would be suspected, the washed clay has a high shrinkage and a tendency to warp.

Production varies considerably, the highest tonnage recorded being in 1928, when about 10,000 tons were mined. The cost is high because the clay must be hauled by truck to El Toro, as much as ten miles distant, loaded into railway cars and shipped from there to the Los Angeles district.

Important clays also occur in Trabuco Creek on the Santa Margarita Ranch. These comprise a wide range of ceramic types and are similar to the Alberhill and Serrano transported fire-clays. They were also deposited within the Martinez formation in a transitional zone between marine and continental areas of sedimentation.

SUMMARY AND CONCLUSIONS

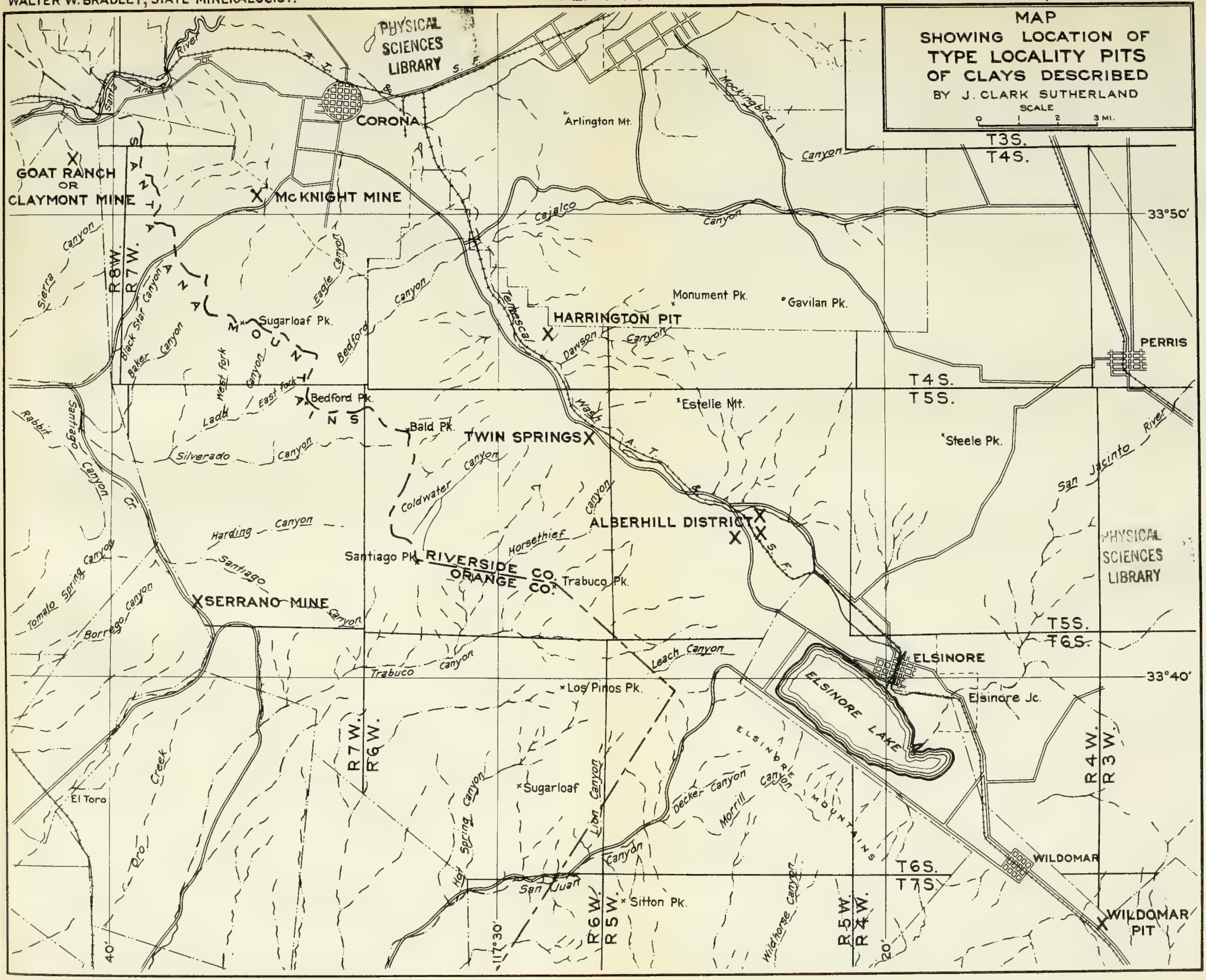
Bordering the Santa Ana Range in Riverside and Orange Counties are found clays which make this area one of the three major-producing districts in California. These clays comprise more than 30 different ceramic types, but may broadly be classified into fire-clays, refractory-bond clays, and red-burning clays according to commercial use, and into residual and transported types according to origin.

In the residual clays, a few of the extremely low-grade deposits are considered to have been derived from the decomposition of phyllites

CALIFORNIA STATE DIVISION OF MINES
WALTER W. BRADLEY, STATE MINERALOGIST.

PLATE I.

GEOLOGIC BRANCH
OLAF P. JENKINS, CHIEF GEOLOGIST.



MAP SHOWING LOCATION OF TYPE LOCALITY PITS OF CLAYS DESCRIBED
BY J. CLARK SUTHERLAND

SCALE
0 1 2 3 MI.
CORONA
Santa Ana River
A. T. & S. F.
Arlington Mt.
Mockingbird Canyon
T3S.
T4S.
GOAT RANCH OR CLAYMONT MINE
McKNIGHT MINE
SANTA ANA MOUNTAINS
Cajalco Canyon
33°50'
Sierra Canyon
R8W.
R7W.
Black Star Canyon
Eagle Canyon
Bedford Canyon
Baker Canyon
Sugarloaf Pk.
Temescal Wash
Monument Pk.
Gavilan Pk.
HARRINGTON PIT
Dawson Canyon
PERRIS
West Fork
Ladd Canyon
East Fork
Bedford Pk.
T4S.
T5S.
Estelle Mt.
Rabbit
Santiago Canyon Cr.
Bald Pk.
TWIN SPRINGS
Steele Pk.
Silverado Canyon
Coldwater Canyon
San Jacinto River
Harding Canyon
Horsethief Canyon
ALBERHILL DISTRICT
Santiago Pk.
RIVERSIDE CO.
ORANGE CO.
Trabuco Pk.
Tomato Spring Canyon
Santiago Canyon
Borrego Canyon
SERRANO MINE
T5S.
T6S.
Leach Canyon
ELSINORE
Trabuco Canyon
33°40'
Los Pinos Pk.
Elsinore Jc.
ELSINORE LAKE
ELSINORE MOUNTAINS
R7W.
R6W.
R4W.
R3W.
Creek
Sugarloaf
Lion Canyon
Decker Canyon
Morrill Canyon
El Toro
Spring Canyon
Oro
Hot Spring Canyon
San Juan Canyon
WILDOMAR
T6S.
T7S.
R6W.
R5W.
Sitton Pk.
Wildhorse Canyon
R5W.
R4W.
WILDOMAR PIT
40'
117°30'
20'

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ACCOMPANYING STATE MINERALOGIST'S REPORT XXXI.

of the basement complex, but the others are thought to represent the product of a process of devitrification and alteration of aphanitic and igneous material, mostly rhyolitic, and thus to be partially bentonitic. Further, within this class are found some deposits in which the volcanics have been altered *in situ*, but most of the commercially important clays of this type are the result of the alteration of the rhyolitic portions of a sedimentary series of conglomerates. These conglomerates occur in close conjunction with clays of the transported class, which are mostly derived by alteration of the feldspars of the plutonic rocks, but which in minor amounts, may have been derived from extrusive igneous rocks.

In the case of the transported clays, which are universally associated with coal, the processes of normal weathering, aided by abundant carbon dioxide, are thought to be the cause of alteration, divitrification, and kaolinization which together gave rise to the formation of the clays. No such explanation, however, is considered adequate to reconcile the existing field relations found in certain of the residual clays which are derived from rhyolitic materials in the sediments. This problem is reserved for future discussion.

Structurally, the clays are found to reflect the diastrophism (faulting and folding) to which the enclosing sediments have been subjected. On the basis of a number of geological criteria, all of the deposits and sediments are in age definitely assigned to the Martinez formation of the Eocene portion of Tertiary time.

OIL FIELD DEVELOPMENT OPERATIONS

R. D. Bush, State Oil and Gas Supervisor

From July 1, 1934, to and including September 29, 1934, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
FRESNO COUNTY:					
Kettleman North Dome Assoc.	32	21 S.	17 E.	52	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	21	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	78	Kettleman North Dome
Standard Oil Co.	21	21 S.	17 E.	38	Kettleman North Dome
Union Oil Co.	29	21 S.	17 E.	King 8	Kettleman North Dome
Western Gulf Oil Co.	11	17 S.	15 E.	S. P. L. 2	
IMPERIAL COUNTY:					
Carl M. Einhart, Trustee	14	11 S.	13 E.	9	
Imperial Carb-Ice Corp.	2	11 S.	13 E.	Imperial Carb-Ice 1	
KERN COUNTY:					
Belridge Oil Co.	35	27 S.	20 E.	10–35	Belridge
Standard Oil Co.	36	27 S.	20 E.	McPhail 1-A	Belridge
Amerada Petroleum Corp. of Calif.	17	26 S.	10 E.	1	Devils Den
Centralia Oil Co.	26	30 S.	29 E.	Centralia-Dowd 1	Edison
Centralia Oil Co.	26	30 S.	29 E.	Centralia-Eubanks 1	Edison
Edison Oil Co.	15	30 S.	29 E.	C. C. M. O. 1	Edison
Gilco, Inc.	23	30 S.	29 E.	Stuart-Gerard 2	Edison
A. T. Jergins Trust	14	30 S.	29 E.	Hershey 1	Edison
Lee Oil Co., Inc.	5	30 S.	29 E.	Edison-Seale-5 1	Edison
Mohawk Petroleum Co.	26	30 S.	29 E.	Weichelt 1	Edison
Monterey Exploration Co.	15	30 S.	29 E.	Duff 4	Edison
The Ohio Oil Co.	36	30 S.	29 E.	Cauley 1	Edison
The Petrol Corp.	35	30 S.	29 E.	Petrol Welch 1	Edison
L. W. Harrison	23	29 S.	27 E.	1	Fruitvale
Western Gulf Oil Co.	22	29 S.	27 E.	14-KCL-B	Fruitvale
Western Gulf Oil Co.	27	29 S.	27 E.	Parker 1	Fruitvale
Western Gulf Oil Co.	27	29 S.	27 E.	Sweitzer 3	Fruitvale
Hugh B. Evans, Inc.	36	28 S.	27 E.	7	Kern River
Rex Oil Co.	4	28 S.	27 E.	Mabry 1	Kern River
Franco Western Oil Co.	8	30 S.	22 E.	11	McKittrick
Welport Oil Co.	26	29 S.	21 E.	106	McKittrick
Honolulu Oil Corp., Ltd.	14	32 S.	24 E.	2	Midway
Standard Oil Co.	21	31 S.	23 E.	79	Midway
Standard Oil Co.	9	32 S.	24 E.	112	Midway
Standard Oil Co.	11	32 S.	24 E.	13	Midway
Standard Oil Co.	11	32 S.	24 E.	93	Midway
Standard Oil Co.	15	32 S.	24 E.	27	Midway
Western Petroleum Co.	24	32 S.	24 E.	W. P. 6	Midway
Pell Petroleum	14	27 S.	27 E.	Vedder 2	Mt. Poso
Shell Oil Co.	4	27 S.	28 E.	Matthew Fee 2	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 9	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 10	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 12	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 13	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder-Rall 4	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder-Rall 5	Mt. Poso
Shell Oil Co.	16	27 S.	28 E.	Security 9	Mt. Poso
Shell Oil Co.	16	27 S.	28 E.	Security 10	Mt. Poso
Union Oil Co.	4	27 S.	28 E.	S. & M. 17	Mt. Poso
Union Oil Co.	4	27 S.	28 E.	S. & M. 18	Mt. Poso
Union Oil Co.	4	27 S.	28 E.	S. & M. 19	Mt. Poso
Union Oil Co.	4	27 S.	28 E.	S. & M. 20	Mt. Poso
Canal Oil Co.	30	30 S.	29 E.	Bloemer 1	Mountain View
General Petroleum Corp.	14	30 S.	28 E.	Brantley 1	Mountain View
General Petroleum Corp.	14	30 S.	28 E.	Brantley 2	Mountain View
The Hancock Oil Co.	14	30 S.	28 E.	Miller 1	Mountain View
A. T. Jergins Trust	30	30 S.	29 E.	Nance 2	Mountain View
A. T. Jergins Trust	30	30 S.	29 E.	Wright-Bloemer 2	Mountain View
Mohawk Petroleum Co.	30	30 S.	29 E.	Clendenen 3	Mountain View
Mohawk Petroleum Co.	30	30 S.	29 E.	Hood 5	Mountain View
Sovereign Oil Corp.	30	30 S.	29 E.	San Joaquin 3	Mountain View
Standard Oil Co.	23	30 S.	28 E.	Wible 1	Mountain View
Standard Oil Co.	23	30 S.	28 E.	Wible 2	Mountain View
Standard Oil Co.	24	30 S.	28 E.	Ranton 2	Mountain View
Standard Oil Co.	24	30 S.	28 E.	Ranton 3	Mountain View
Standard Oil Co.	19	30 S.	29 E.	Nichols Comm. 2	Mountain View
The Texas Co.	14	30 S.	28 E.	Mateo Smith 1	Mountain View
Union Oil Co.	15	30 S.	28 E.	Kernco 3	Mountain View
Union Oil Co.	23	30 S.	28 E.	Wible 2	Mountain View
Wood-Callahan Oil Co., Ltd.	30	30 S.	29 E.	National Oil 2	Mountain View
Royal Oil Co.	24	28 S.	28 E.	Royal 1	Round Mountain

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued					
P. H. Greer Co., Inc.	9	31 S.	29 E.	Perrel 1	
Home Corp., Ltd.	16	26 S.	27 E.	Jessup, et al. 1	
The Ohio Oil Co.	22	27 S.	27 E.	Brown 1	
Regina Oil Corp., Ltd.	27	10 N.	14 W.	Lucky Strike 1	
Tejon Ridge Oil Co.	23	32 S.	29 E.	Tejon 1	
Trico Oil and Gas Co.	3	25 S.	23 E.	2	
KINGS COUNTY:					
Standard Oil Co.	35	21 S.	17 E.	4	Kettleman North Dome
LOS ANGELES COUNTY:					
Shell Oil Co.	34	3 S.	13 W.	Reyes 58	Dominguez
Shell Oil Co.	34	3 S.	13 W.	Reyes 59	Dominguez
Shell Oil Co.	34	3 S.	13 W.	Reyes 60	Dominguez
Foster, Inc.	17	2 S.	14 W.	Foster 1	Inglewood
Standard Oil Co.	8	2 S.	14 W.	Vickers 1	Inglewood
Standard Oil Co.	17	2 S.	14 W.	L. A. Investment Lease 71	Inglewood
Aztec Drilling Corp.	29	4 S.	12 W.	Aztec 1	Long Beach
Bernal Oil Co.	19	4 S.	12 W.	1	Long Beach
Bernal Oil Co.	19	4 S.	12 W.	2	Long Beach
Russell B. Coffman	30	4 S.	12 W.	1	Long Beach
Commercial Drilling Co., Inc.	30	4 S.	12 W.	Commercial 2	Long Beach
Congo Oil Co., Ltd.	30	4 S.	12 W.	Congo 1	Long Beach
Deco Oil Co.	30	4 S.	12 W.	Deco 2	Long Beach
D. D. Dunlap	30	4 S.	12 W.	9	Long Beach
Hil-Mar Drilling Co., Inc.	30	4 S.	12 W.	1	Long Beach
P. A. Kingsland	20	4 S.	12 W.	P. A. Kingsland 7	Long Beach
M. & O. Oil Co.	19	4 S.	12 W.	M. & O. 9	Long Beach
Madison Oil Co.	30	4 S.	12 W.	L. B. 1	Long Beach
Samuel Ohenstein and Geo. C. Withers	29	4 S.	12 W.	Baehr 2-A	Long Beach
Union Oil Co.	30	4 S.	12 W.	Long Beach Comm. 24	Long Beach
Charles W. Fourl	27	2 S.	15 W.	Fourl 1	Playa del Rey
The Ohio Oil Co.	28	2 S.	15 W.	Recreation Gun Club 15	Playa del Rey
Bandini Petroleum Co.	5	3 S.	11 W.	Off 20	Santa Fe Springs
General Petroleum Corp.	5	3 S.	11 W.	Santa Fe 25	Santa Fe Springs
General Petroleum Corp.	5	3 S.	11 W.	Santa Fe 36	Santa Fe Springs
The Texas Co.	5	3 S.	11 W.	Wickman 6	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 67	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 69	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 70	Santa Fe Springs
Aron H. Hover Organization	31	3 S.	14 W.	Bryant 1	Torrance
Barstow Oil Co.	35	5 N.	16 W.	Walker 2	
N. O. Shively	14	2 S.	10 W.	Shively 1	
ORANGE COUNTY:					
General Petroleum Corp.	6	3 S.	9 W.	Tonner 15	Brea-Olinda
Great American Petroleum Co.	19	3 S.	9 W.	Tuffree 2	Coyote Hills
Concord Oil Co.	35	5 S.	11 W.	2	Huntington Beach
Dome Oil Co.	14	6 S.	11 W.	Newland-Borchard 1	Huntington Beach
Standard Oil Co.	4	6 S.	11 W.	Huntington B. 70	Huntington Beach
Standard Oil Co.	4	6 S.	11 W.	P. E. 24	Huntington Beach
Standard Oil Co.	4	6 S.	11 W.	P. E. 25	Huntington Beach
West American Oil Co.	34	5 S.	11 W.	W. A. 7	Huntington Beach
W. G. Bradford	19	6 S.	10 W.	B. B. 1	
RIVERSIDE COUNTY:					
Great Coastal Oil Corp.	36	5 S.	5 W.	1	
SACRAMENTO COUNTY:					
Great American Petroleum Co.	25	5 N.	7 E.	Rubens 1	
SAN BERNARDINO COUNTY:					
Carl E. Braly	22	3 N.	6 W.	Davis 1	
Great American Petroleum Co.	7	2 S.	8 W.	D-1	
SAN DIEGO COUNTY:					
Everts Drilling Co.	23	15 S.	3 W.	1	
SAN JOAQUIN COUNTY:					
Milham Exploration Co.	24	3 S.	4 E.	Moy 1	
Milham Exploration Co.	24	3 S.	4 E.	Moy 2	
SANTA BARBARA COUNTY:					
General Petroleum Corp.	32	5 N.	30 W.	Erburu 1	Capitan
Barnsdall Oil Co.	16	4 N.	29 W.	88–8A	Elwood
Pacific Western Oil Co.	16	4 N.	23 W.	92–13	Elwood
Signal Oil and Gas Co.	16	4 N.	29 W.	Appleford 98–3	Elwood

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
SANTA BARBARA COUNTY—Cont.					
Allied Petroleum Corp.	28	4 N.	27 W.	Allied 14	Mesa
Allied Petroleum Corp.	28	4 N.	27 W.	Allied 15	Mesa
Barmesa Oil Co.	28	4 N.	27 W.	1	Mesa
Beloil Corp., Ltd.	28	4 N.	27 W.	Cal-State 1	Mesa
Beloil Corp., Ltd.	28	4 N.	27 W.	Martin 1	Mesa
Beloil Corp., Ltd.	28	4 N.	27 W.	Martin 2	Mesa
Fred E. Cole	28	4 N.	27 W.	Perkins 2	Mesa
Fairacres Oil Co.	28	4 N.	27 W.	Anchordoquy 1	Mesa
Fairacres Oil Co.	28	4 N.	27 W.	T. L. & B. A. 1	Mesa
Fair Mesa Oil Co.	28	4 N.	27 W.	Gray 1	Mesa
Fornachon and Wilson, Inc.	28	4 N.	27 W.	1	Mesa
William Hughes	28	4 N.	27 W.	Hicks 1	Mesa
Pierre J. Loustalot	28	4 N.	27 W.	Tooley 1	Mesa
Midcoast Oil Co.	28	4 N.	27 W.	Rogers 3	Mesa
Moss & Walker	28	4 N.	27 W.	Schuldt 1	Mesa
Trans-Oceanic Oil Corp.	28	4 N.	27 W.	Morrison 1	Mesa
Glenn A. West	28	4 N.	27 W.	Security 1	Mesa
North American Oil Consolidated	10	4 N.	28 W.	Pinkham 1	
Petroleum Securities Co.	6	7 N.	32 W.	Los Alamos 1	
Royalty Service Corp., Ltd.	35	9 N.	32 W.	Sisquoc 1	
SUTTER COUNTY:					
Tannehill Oil Co.	36	16 N.	1 W.	Maggie Wilson 1	
TEHAMA COUNTY:					
Northern Counties Petroleum Co.	25	24 N.	3 W.	Ewers-Mooney 1	
VENTURA COUNTY:					
Commander Oil Co., Ltd.	13	4 N.	19 W.	6-F	Piru
Sullivan & Roberts	28	5 N.	19 W.	1	Sespe
N. D. Dakis	6	2 N.	17 W.	Dakis 1	Simi
Dawson Oil Co.	5	2 N.	17 W.	Dawson 1	Simi
Associated Oil Co.	26	3 N.	23 W.	V. L. & W. 16	Ventura
Shell Oil Co.	29	3 N.	23 W.	Taylor 82	Ventura
Paloma Oil Co.	12	2 N.	18 W.	Paloma Marr 1	
Rancho Oils, Inc.	18	5 N.	23 W.	W. F. Battin 1	

OIL FIELD DEVELOPMENT OPERATIONS—Continued

R. D. Bush, State Oil and Gas Supervisor

From September 30, 1934, to and including December 29, 1934, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
FRESNO COUNTY:					
The Texas Co.	35	20 S.	14 E.	Circle 1	Coalinga
John F. Wilcox	11	20 S.	14 E.	2	Coalinga
Kettleman North Dome Assoc.	20	21 S.	17 E.	8	Kettleman North Dome
Kettleman North Dome Assoc.	20	21 S.	17 E.	43	Kettleman North Dome
Kettleman North Dome Assoc.	28	21 S.	17 E.	45	Kettleman North Dome
Kettleman North Dome Assoc.	30	21 S.	17 E.	81	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	36	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	76	Kettleman North Dome
Standard Oil Co.	27	21 S.	17 E.	36	Kettleman North Dome
Standard Oil Co.	29	21 S.	17 E.	21	Kettleman North Dome
Standard Oil Co.	33	21 S.	17 E.	47	Kettleman North Dome
HUMBOLDT COUNTY:					
The Texas Co.	1	3 N.	2 W.	Eureka 1	
KERN COUNTY:					
Belridge Oil Co.	35	27 S.	20 E.	22–35	Belridge
Richfield Oil Co.	14	25 S.	18 E.	Alferitz 2	Devils Den
Consolidated Crude Corp.	17	30 S.	29 E.	Bloemer-Jeppi 1	Edison
Foster, Incorporated	8	30 S.	29 E.	Osborn 1	Edison
General Petroleum Corp.	14	30 S.	29 E.	Leddy-Nichols 1	Edison
General Petroleum Corp.	15	30 S.	29 E.	Jed 1	Edison
General Petroleum Corp.	15	30 S.	29 E.	Jed 2	Edison
A. T. Jergins Trust	23	30 S.	29 E.	R. R. Andrews 1	Edison
A. T. Jergins Trust	24	30 S.	29 E.	Davis 1	Edison
Lee Oil Co., Inc.	5	30 S.	29 E.	Edison-Seale-5 1	Edison
Monterey Exploration Co.	15	30 S.	29 E.	Duff 7	Edison
Monterey Exploration Co.	15	30 S.	29 E.	Duff 8	Edison
North American Oil Consolidated	14	30 S.	29 E.	Brown 1	Edison
The Ohio Oil Co.	36	30 S.	29 E.	Cauley 2	Edison
Shell Oil Co.	14	30 S.	29 E.	Brown 1	Edison
Shell Oil Co.	14	30 S.	29 E.	Nichols 1	Edison
Shell Oil Co.	15	30 S.	29 E.	Duff 3	Edison
Shell Oil Co.	15	30 S.	29 E.	Duff 5	Edison
Shell Oil Co.	15	30 S.	29 E.	Osborne 1	Edison
The Texas Co.	4	30 S.	29 E.	Edison Seale 4–25	Edison
The Paroil Co.	23	29 S.	27 E.	1	Fruitvale
Western Gulf Oil Co.	22	29 S.	27 E.	15-KCL-B	Fruitvale
Western Gulf Oil Co.	22	29 S.	27 E.	16-KCL-B	Fruitvale
Western Gulf Oil Co.	22	29 S.	27 E.	Price & Stewart 4	Fruitvale
The Kern River Oilfields of California, Ltd.	25	28 S.	27 E.	1	Kern River
The Ohio Oil Co.	32	27 S.	27 E.	Midway Premier 3	Kern River
Associated Oil Co.	2	26 S.	20 E.	Williamson 2	Lost Hills
Welport Oil Co.	26	29 S.	21 E.	10	McKittrick
Honolulu Oil Corp., Ltd.	8	32 S.	24 E.	53	Midway
Honolulu Oil Corp., Ltd.	14	32 S.	24 E.	1	Midway
Honolulu Oil Corp., Ltd.	14	32 S.	24 E.	3	Midway
Honolulu Oil Corp., Ltd.	14	32 S.	24 E.	4	Midway
Honolulu Oil Corp., Ltd.	14	32 S.	24 E.	5	Midway
Honolulu Oil Corp., Ltd.	14	32 S.	24 E.	21	Midway
Honolulu Oil Corp., Ltd.	14	32 S.	24 E.	22	Midway
Honolulu Oil Corp., Ltd.	14	32 S.	24 E.	41	Midway
Honolulu Oil Corp., Ltd.	14	32 S.	24 E.	43	Midway
Pan American Petroleum Co.	22	32 S.	23 E.	Buena Fe 30	Midway
Standard Oil Co.	15	32 S.	24 E.	25	Midway
Buckeye Union Oil Co.	11	27 S.	27 E.	New Hope 1	Mt. Poso
J. N. Kerwin and George C. Champ	33	26 S.	28 E.	1	Mt. Poso
Modoc Petroleum, Ltd.	28	26 S.	28 E.	Johnson 3	Mt. Poso
Pongratz Petroleum Co.	10	27 S.	28 E.	Pongratz 4	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 14	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 16	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder-Rall 6	Mt. Poso
Shell Oil Co.	15	27 S.	28 E.	Glide 4	Mt. Poso
Shell Oil Co.	16	27 S.	28 E.	Security 11	Mt. Poso
Shell Oil Co.	16	27 S.	28 E.	Security 12	Mt. Poso
Shell Oil Co.	16	27 S.	28 E.	Security 13	Mt. Poso
Union Oil Co.	4	27 S.	28 E.	S. & M. 21	Mt. Poso
Associated Oil Co.	14	30 S.	28 E.	Nunez 1	Mountain View
Associated Oil Co.	3	31 S.	29 E.	DiGiorgio Farms 1	Mountain Veiw
Barnsdall Oil Co.	32	30 S.	29 E.	Morris 2	Mountain View
Gilmore-Snyder Co.	24	30 S.	28 E.	Mullaney 1	Mountain View

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued					
The Hancock Oil Co.	14	30 S.	28 E.	Miller 2	Mountain View
The Hancock Oil Co.	14	30 S.	28 E.	Miller 3	Mountain View
Hogan Petroleum Co.	4	31 S.	29 E.	Symons 1	Mountain View
Major Oil Co., Ltd.	18	30 S.	29 E.	Major Oil 1	Mountain View
Mohawk Petroleum Co.	24	30 S.	28 E.	Mabry 2	Mountain View
The Ohio Oil Co.	33	30 S.	29 E.	Derby 1	Mountain View
Standard Oil Co.	23	30 S.	28 E.	Wible 3	Mountain View
Star Petroleum Co. of California, Ltd.	10	30 S.	28 E.	Bakersfield-Star 1	Mountain View
The Texas Co.	14	30 S.	28 E.	Mateo Smith 3	Mountain View
The Texas Co.	14	30 S.	28 E.	Mateo Smith 4	Mountain View
The Texas Co.	14	30 S.	29 E.	Schamblin 1	Mountain View
Union Oil Co.	9	30 S.	28 E.	Kernco B-1	Mountain View
Union Oil Co.	15	30 S.	28 E.	Kernco 4	Mountain View
Union Oil Co.	23	30 S.	28 E.	Wible 3	Mountain View
Wood-Callahan Oil Co., Ltd.	30	30 S.	29 E.	National Oil 3	Mountain View
Buckeye Union Oil Co.	10	27 S.	27 E.	New Hope Claflin 1	Poso Creek
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	32	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	76	Round Mountain
Hallmark Oil Co., Inc.	25	12 N.	24 W.	1-A	Sunset
Signal Oil and Gas Co.	8	11 N.	23 W.	Signal Wallace 3	Sunset
The Texas Co.	29	29 S.	21 E.	Jared How 1	Temblor
Cimarron Oil Corp.	14	25 S.	27 E.	Quinn 1	
Petroleum Drilling and Exploration Co., Inc.	22	29 S.	29 E.	Beaizley 1	
Reserve Oil and Gas Co.	2	10 N.	19 W.	Tejon Ranch 1	
Sea Cliff Oil Co., Ltd.	7	31 S.	28 E.	Sea Cliff-Houghton 1	
Seeple Oil Corp.	5	30 S.	24 E.	Buttonwillow 1	
Shell Oil Co.	9	32 S.	25 E.	B. V. A. 1	
Signal Oil and Gas Co.	31	29 S.	30 E.	Southern Pacific Land Co. 1	
Signal Oil and Gas Co.	5	30 S.	30 E.	Brown 1	
Standard Oil Co.	8	27 S.	23 E.	Hill 1	
KINGS COUNTY:					
Standard Oil Co.	29	23 S.	17 E.	38	Kettleman Middle Dome
Associated Oil Co.	35	21 S.	17 E.	Whepley 5	Kettleman North Dome
Petroleum Securities Co.	35	21 S.	17 E.	Felix 4	Kettleman North Dome
Standard Oil Co.	35	21 S.	17 E.	45	Kettleman North Dome
Trico Oil and Gas Co.	36	24 S.	22 E.	3	
LOS ANGELES COUNTY:					
Shell Oil Co.	33	3 S.	13 W.	Reyes 63	Dominguez
Shell Oil Co.	34	3 S.	13 W.	Reyes 61	Dominguez
Shell Oil Co.	34	3 S.	13 W.	Reyes 62	Dominguez
Shell Oil Co.	34	3 S.	13 W.	Reyes 64	Dominguez
Allen Petroleum Co.	29	4 S.	12 W.	1	Long Beach
Bernal Oil Co.	19	4 S.	12 W.	3	Long Beach
Boswell Petroleum Co.	29	4 S.	12 W.	Crest 1	Long Beach
Bremmor Petroleum Corp.	30	4 S.	12 W.	Roberts 1	Long Beach
R. R. Bush Oil Co.	20	4 S.	12 W.	Fee 4	Long Beach
Chief Oil Co.	30	4 S.	12 W.	Chief 2	Long Beach
J. H. Cochran	30	4 S.	12 W.	9	Long Beach
Cochran & Taylor Oil Co.	30	4 S.	12 W.	Cochran 10	Long Beach
Commercial Producing Corp.	30	4 S.	12 W.	Commercial 3	Long Beach
H. C. Domengeaux	30	4 S.	12 W.	Jackson 2	Long Beach
Geneva Marie Co.	30	4 S.	12 W.	1	Long Beach
R. L. Goetz	19	4 S.	12 W.	Goetz 3	Long Beach
Good-Rich Oil Corp., Ltd.	30	4 S.	12 W.	1	Long Beach
Hil-Mar Drilling Co., Inc.	30	4 S.	12 W.	2	Long Beach
Huntington Investment Corp.	30	4 S.	12 W.	1	Long Beach
Huntington Investment Corp.	30	4 S.	12 W.	2	Long Beach
P. A. Kingsland	30	4 S.	12 W.	P. A. Kingsland 8	Long Beach
Kiowa Petroleum Corp.	30	4 S.	12 W.	Kiowa 1	Long Beach
Mastadon Oil Corp.	30	4 S.	12 W.	Mastadon 2	Long Beach
Milpet Corp.	30	4 S.	12 W.	Campbell 8	Long Beach
E. L. Olmstead Oil Co.	30	4 S.	12 W.	McKenzie 2	Long Beach
Pacific Empire Petroleum, Inc.	30	4 S.	12 W.	Empire 3	Long Beach
Pencole Petroleum	30	4 S.	12 W.	Fee 1	Long Beach
San Andreas Oil Co., Inc.	30	4 S.	12 W.	1	Long Beach
Sentinel Oil Co.	30	4 S.	12 W.	Sentinel 1	Long Beach
Southern California Drilling Co.	29	4 S.	12 W.	Miller 3	Long Beach
Twentieth Century Oil Co.	29	4 S.	12 W.	Prosperity 1	Long Beach
Union Oil Co.	30	4 S.	12 W.	Long Beach Comm. 25	Long Beach
Willow Oil Co.	20	4 S.	12 W.	Poitevin 1	Long Beach
Chester F. Yunker & Associates	19	4 S.	12 W.	2	Long Beach
Standard Oil Co.	6	2 S.	11 W.	Baldwin 77	Montebello

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Continued					
Universal Consolidated Oil Co.	5	2 S.	11 W.	N-1	Montebello
Universal Consolidated Oil Co.	5	2 S.	11 W.	N-2	Montebello
Big Ben Oil Co.	27	2 S.	15 W.	Big Ben 1	Playa del Rey
D. D. Dunlap Oil Co.	27	2 S.	15 W.	Del Rey 1	Playa del Rey
Madison Oil Co.	27	2 S.	15 W.	Madison 1	Playa del Rey
Pacific Drilling Corp.	27	2 S.	15 W.	Del Rey 1	Playa del Rey
The Petrol Corp.	27	2 S.	15 W.	Bergman 1	Playa del Rey
Union Oil Co.	27	2 S.	15 W.	King Vidor 6	Playa del Rey
Union Oil Co.	27	2 S.	15 W.	King Vidor 7	Playa del Rey
Union Oil Co.	28	2 S.	15 W.	Del Rey 7	Playa del Rey
Union Oil Co.	31	2 S.	11 W.	Bell 72	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Alexander 25	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 68	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 71	Santa Fe Springs
C. W. Partridge & Wm. Chambers	22	2 S.	11 W.	5	Whittier
Frederick A. Speik	2	3 S.	14 W.	Johnson 1	
Vanco Development Co., Ltd.	25	3 S.	12 W.	Millard 1	
MONTEREY COUNTY:					
Thomas Petroleum Corp.	31	22 S.	14 E.	Flentge 3	
ORANGE COUNTY:					
Standard Oil Co.	18	3 S.	10 W.	Murphy-Coyote 120	Coyote Hills
Standard Oil Co.	3	6 S.	11 W.	Huntington B 72	Huntington Beach
Standard Oil Co.	4	6 S.	11 W.	Huntington B 71	Huntington Beach
RIVERSIDE COUNTY:					
Corona Oil Co., Ltd.	27	3 S.	7 W.	Wardlow 1	
SANTA BARBARA COUNTY:					
General Petroleum Corp.	32	5 N.	30 W.	Erburu 12	Capitan
Shell Oil Co.	32	5 N.	30 W.	Covarrubias 14	Capitan
Bankline Oil Co.	15	4 N.	29 W.	89–8	Elwood
Caroline C. Spalding	16	4 N.	29 W.	Blue Goose-93 9	Elwood
York-Smullin Oil Co.	33	8 N.	34 W.	A–1	Lompoc
Allied Petroleum Corp.	28	4 N.	27 W.	Allied 16	Mesa
E. C. Arnold	28	4 N.	27 W.	Adams 1	Mesa
E. C. Arnold	28	4 N.	27 W.	Booher 1	Mesa
Bastanchury Oil Co.	28	4 N.	27 W.	2	Mesa
Bastanchury Oil Co.	28	4 N.	27 W.	Bastanchury 1	Mesa
Bernstein Mathes Oil Co.	28	4 N.	27 W.	1	Mesa
Fred E. Cole	28	4 N.	27 W.	Cole 6	Mesa
Fred E. Cole	28	4 N.	27 W.	Cole 7	Mesa
Fred E. Cole	28	4 N.	27 W.	Cole 8	Mesa
Fred E. Cole	28	4 N.	27 W.	Perkins 3	Mesa
Crude Oil Drilling Co., Ltd.	28	4 N.	27 W.	1	Mesa
Fair Mesa Oil Co.	28	4 N.	27 W.	Gray 2	Mesa
Daniel Fisher	28	4 N.	27 W.	Fisher 1	Mesa
Fornachon and Wilson, Inc.	28	4 N.	27 W.	2	Mesa
Rex C. Gale	28	4 N.	27 W.	1	Mesa
W. F. Higgins	28	4 N.	27 W.	8	Mesa
Jordan and Maney	28	4 N.	27 W.	Hels 1	Mesa
Jordan and Maney	28	4 N.	27 W.	Tye 1	Mesa
Mac Oil Corp.	28	4 N.	27 W.	Mac 1	Mesa
Mission Oil Co.	28	4 N.	27 W.	1	Mesa
Moss & Walker	28	4 N.	27 W.	Securities 1	Mesa
Moss & Walker	28	4 N.	27 W.	Securities 2	Mesa
Rio Grande Oil Co.	28	4 N.	27 W.	Perkins 1	Mesa
Rio Grande Oil Co.	28	4 N.	27 W.	Perkins 2	Mesa
Rio Grande Oil Co.	28	4 N.	27 W.	Perkins 3	Mesa
Rio Grande Oil Co.	28	4 N.	27 W.	Perkins 4	Mesa
Charles L. Ross	28	4 N.	27 W.	Adams 1	Mesa
Jacques Vinmont	29	4 N.	27 W.	Low 1	Mesa
Union Oil Co.	23	10 N.	34 W.	Enos 1	
VENTURA COUNTY:					
Daniel Fisher	5	3 N.	19 W.	Elkins 4	Bardsdale
Continental Oil Co.	13	4 N.	23 W.	Pirie 1	Ojai
Bolsa Chica Oil Corp.	4	4 N.	18 W.	Snow 2	Piru
Associated Oil Co.	26	3 N.	23 W.	Lloyd 92	Ventura
Griffith & Fletcher	34	4 N.	23 W.	7	Ventura
Kittrell & Tucker	33	4 N.	23 W.	25	Ventura
Shell Oil Co.	28	3 N.	23 W.	Gosnell 36	Ventura
Shell Oil Co.	29	3 N.	23 W.	Taylor 83	Ventura
Shell Oil Co.	29	3 N.	23 W.	Taylor 84	Ventura

SPECIAL ARTICLES

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of the new laws and official regulations and notices affecting the mineral industry.

INFORMATION REGARDING MINING LOANS BY THE RECONSTRUCTION FINANCE CORPORATION

On January 31, 1935, the President signed the act passed by the Seventy-fourth Congress extending the life of the R.F.C. which contains an amendment to section 14, permitting loans for development purposes. The amendment was introduced by Congressman James G. Scrugham of Nevada. The amended text as adopted follows:

SEC. 14. The Reconstruction Finance Corporation is authorized and empowered to make loans upon sufficient security to recognized and established corporations, individuals, and partnerships, engaged in the business of mining, milling, or smelting ores. The Reconstruction Finance Corporation is authorized and empowered also to make loans to corporations, individuals and partnerships, engaged in the development of a quartz ledge, or vein, or other ore body, or placer deposit, containing gold, silver, or tin, or gold and silver, when, in the opinion of the Reconstruction Finance Corporation, there is sufficient reason to believe that, through the use of such loan in the development of a lode, ledge, or vein, or mineral deposit, or placer gravel deposit, there will be developed a sufficient quantity of ore, or placer deposits of a sufficient value to pay a profit upon mining operations: *Provided*, That not to exceed twenty thousand dollars shall be loaned to any corporation, individual, or partnership, for such development purposes: *Provided, further*, that there shall not be allocated or made available for such development loans a sum in excess of ten million dollars.

APPLICANTS

This act provides for two types of loans as follows:

A. Loans upon ''sufficient security'' to recognized and established corporations, individuals, and partnerships engaged in the business of mining, milling, or smelting ores. These loans are hereinafter designated as ''loans for general mining, milling, and smelting purposes.''

B. Limited loans ''to corporations, individuals, and partnerships engaged in the development of quartz ledge, or vein, or other ore body, or placer deposit, containing gold, silver, or tin, or gold and silver.'' These loans are hereinafter designated as ''loans for development.''

A. LOANS FOR GENERAL MINING, MILLING, AND SMELTING PURPOSES

1. Eligibility.

Applications for loans will be considered when presented by ''recognized and established corporations, individuals, and partnerships engaged in the business of mining, milling, or smelting ores.'' The

Corporation will determine from the facts and circumstances in each particular case what constitutes "recognized and established" and "engaged in the business of mining, milling, or smelting ores." As the word "ore" is construed to mean any native compound from which a metal or metals can be commercially extracted at a profit, thus coal or other nonmetallic minerals, salts, or other similar substances do not come within the purview of this section.

2. Purposes.

(a) Fixed Capital.—Loans may be made for construction, improvement, repair, purchase, or equipment and other fixed-capital purposes.

(b) Working Capital.—Loans may be made to provide working capital needed in connection with mining, milling, or smelting ores.

(c) Loans for Tax Payment.—An incidental portion of the loan authorized may, under certain circumstances, be permitted to be applied to the payment of taxes on properties which are necessary to the operation of applicant's mining, milling, or smelting business.

3. Amount.

Loans will be limited to an amount reasonably required to accomplish the purposes for which they may be authorized.

4. Security.

The set requires "sufficient security" for these loans. Such security may consist of a mortgage on the mining, milling, or smelting property, or it may consist of a lien on property, real or personal, entirely independent of the mining project, provided it constitutes "sufficient security" in the opinion of this Corporation. If mining property is offered, there should be blocked out ore, sufficient in quality and quantity to establish the value claimed. An assignment of a favorable milling, smelting, sales, or transportation contract may also be required.

5. Deposit to Cover Cost of Examination.

The applicant may be requested to make a deposit, in an amount to be determined in each case by the Corporation, to cover the cost of any field work which may be necessary in connection with the examination of the property of the applicant, and when such request is made an examination will not be undertaken until the required deposit is made.

B. LOANS FOR DEVELOPMENT

1. Eligibility.

Loans may be made "to corporations, individuals, and partnerships engaged in the development of a quartz ledge, or vein, or other ore body, or placer deposit, containing gold, silver, or tin, or gold and silver."

2. Purposes.

A loan may be made, when, in the opinion of this Corporation, there is sufficient reason to believe that there will be developed a lode, ledge, or vein, or mineral deposit, or gravel deposit containing a quantity of ore, or placer deposits of sufficient value to pay a profit if mined. The proceeds of such loans will be expended subject to the approval of this Corporation.

3. Amount.

"Not to exceed $20,000 shall be loaned to any Corporation, individual, or partnership, for such development purposes." However, such loans will be limited to an amount reasonably required to pay for the cost of the contemplated development, including purchase of material and supplies.

4. Security.

The security offered must be satisfactory to the Corporation.

5. Cost of Examination.

This Corporation may deduct a reasonable amount from the loan to cover the cost of any field work which may be necessary in connection with the examination of the property of the applicant.

C. GENERAL PROVISIONS APPLICABLE TO BOTH CLASSES OF LOANS

1. Rate of Interest.

Interest will be determined in each case by the Corporation.

2. Maturities.

Loans may be made for such a period of time as the Corporation shall in each instance determine.

3. Unacceptable Purposes.

Loans will not be granted for the purpose of purchasing mineral acreage, nor where the loan is promotional or for prospecting purposes.

4. Existing Indebtedness.

In cases where the applicant has substantial outstanding indebtedness and its properties, which are to be the security for the loan, are encumbered, it will be necessary for such applicant to work out an arrangement with existing creditors whereby, in consideration of new capital coming into the business, payments of existing indebtedness and encumbrances may be arranged or deferred or subordinated on terms satisfactory to the Corporation.

5. Disbursements.

No money will be disbursed on a loan until a mortgage has been duly executed and recorded, or other security assigned or pledged to the satisfaction of this Corporation, and other requirements complied with. Such loans will be disbursed in installments as required to defray the cost of the work as it progresses or to purchase supplies and equipment.

6. Compliance With N.R.A. Code.

Each applicant must execute a certificate that it is complying with and will continue to comply with the approved code of fair competition for the type of operation being conducted by the applicant, or, if there be no approved code of fair competition for the business in which the applicant is engaged, that it has signed, and is complying with or will continue to comply with, the President's Reemployment Agreement promulgated under authority of section 4(a) of the National Industrial Recovery Act and/or any other agreement promulgated by the President under the National Industrial Recovery Act.

In order to comply with Executive Order No. 6646, issued by the President of the United States on March 14, 1934, each applicant must agree that all contracts and orders by the applicant, or by its general contractor, if any, for machinery, articles, materials, or services, to be acquired, in whole or in part, with any of the proceeds of the loan, shall require, before performance or delivery, a certificate as hereinafter described signed by the party awarded such contract or order and by all concerns supplying, directly or indirectly, the aforesaid machinery, articles, materials, or services. Such certificate shall state that the party signing it is complying with and shall continue to comply with each approved code of fair competition to which it is subject; or, if engaged in any trade or industry for which there is no approved code of fair competition, the certificate shall state that the party signing it has become a party to, is complying with and shall continue to comply with the agreement with the President under section 4(a) of the National Industrial Recovery Act and/or any other agreement promulgated by the President under the National Industrial Recovery Act. In the event that invitations for bids are issued by the applicant, or by its general contractor, if any, for machinery, articles, materials, or services, to be acquired in whole or in part with any of the proceeds of the loan, they shall require the bid to contain such a certificate by the bidder, and an agreement by the bidder to obtain such a certificate from all concerns supplying, directly or indirectly, the aforesaid machinery, articles, materials, or services. Each applicant must give the Corporation such proof of fulfillment of its agreement as the Corporation may require.

7. Compliance With Other Federal Regulations.

Each applicant must agree to comply with the regulations relating to pay for labor promulgated by the Secretary of the Interior and the Secretary of the Treasury, under date of January 8, 1935 (which is set forth in full in exhibit I of the application) as well as with all other regulations which may be promulgated by the President of the United States or any other duly authorized officer.

8. Charges, Commissions, Bonuses, Fees, Etc.

Payment of bonuses, fees, or commissions for the purpose of, or in connection with, obtaining loans is prohibited. The borrower, however, subject to the prior approval of the Corporation, may be allowed to pay the actual reasonable costs incurred in connection with the loan. Such charges may include reasonable compensation for services rendered by attorneys, appraisers, accountants, etc., but not in any event for alleged services in connection with the presentation of the application to the Corporation. Such charges must be fully disclosed. A fee based upon a percentage of the loans will be objected to, as also will fees or charges made contingent upon the obtaining of the loan. Applicants will be required to furnish satisfactory proof in the application that no bonus, fee, or comission has been or will be paid, and that no compensation, other than reasonable compensation for services required in making the loan, fully disclosed and itemized, has been or will be paid.

9. Salaries.

The applicant must agree that, so long as any portion of the loan remains unpaid, applicant will not pay any salaries which are not deemed by the Corporation to be reasonable.

10. Dividends.

So long as any portion of the loan remains outstanding, no dividends may be paid by any corporate applicant nor any distribution (except compensation for service regarded by the Corporation as reasonable) made by partnership or individual applicants, without the consent of the Corporation.

11. Legal Opinions.

Before any loan will be disbursed, applicant, at his or its expense, may be required to furnish this Corporation with a policy of title insurance issued by a title insurance company approved by this Corporation or a legal opinion, rendered by an attorney of reputable standing, approved by this Corporation, in form satisfactory to its Counsel.

12. Reports.

Applicant shall furnish with the application reports only as are in its possession or are available to such applicant, pertaining to the properties involved, made by engineers or accountants.

13. Method of Filing Application.

Applications should be filed direct with the Reconstruction Finance Corporation at its office at 1825 H Street NW., Washington, D. C. Forms for applications may be secured by writing to the Washington office of the Corporation. No applications will be considered unless submitted on the proper forms. Care should be taken to submit a complete statement setting forth all information which is requested.

ADMINISTRATIVE

WALTER W. BRADLEY, State Mineralogist

Personnel.

There have been no changes of personnel in the Division of Mines to be noted during the past three months.

New Publications.

'CALIFORNIA JOURNAL OF MINES AND GEOLOGY' (quarterly), October, 1934, being chapter 4 of the State Mineralogist's Report XXX; price 40 cents, plus 10 cents postage. Contains: 'Current Mining Developments in Northern California'; 'Current Mining Activity in Southern California'; 'Geology and Mineral Deposits of the Julian District, San Diego County' (with map); 'Geology and Mineral Deposits of the Elizabeth Lake Quadrangle' (with map); 'Geologic Features of the Dry Placers of the Northern Mojave Desert'; 'Biennial Report of the State Mineralogist'; 'Government Can Not Challenge Right to Mining Claims for Failure to Perform Annual Assessment Work Within Withdrawn Areas'; 'Death Valley National Monument Is Now Open to Mining'; 'Summary of Mineral Production Statistics for Year 1933'.

Bulletin No. 108, 'Mother Lode Gold Belt of California' by Clarence A. Logan, 240 pp., 33 illustrations, 10 plates (including a geologic and claim map of each of the five counties covering the 'lode'); price, $1.75, plus 15 cents postage.

Commercial Mineral Notes, Nos. 139–141 (inclusive), November-January (inclusive) 1934–1935, respectively. These 'Notes' contain the lists of 'mineral deposits wanted,' and 'mineral deposits for sale,' issued in the form of a mimeographed sheet monthly. It is mailed free to those on the mailing list for "California Journal of Mines and Geology." As an evidence of the interest in mines and mineral resources now showing considerable activity, this mimeographed 'sheet' has had to be expanded to three pages in recent months.

Mails and Files.

The Division of Mines maintains, in addition to its correspondence files and the library, a mine file which includes original reports on the various mines and mineral properties of all kinds in California.

During each quarterly period there are several thousand letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, marketing of refined products and mining law. In addition to this, hundreds of oral questions are answered daily, both at the main office and the district offices, for the many inquirers who come in for personal intervews and to consult the files and library.

MINERALS AND STATISTICS

Statistics, Museum, Laboratory

HENRY H. SYMONS, Statistician and Curator

STATISTICS

CALIFORNIA'S MINERAL PRODUCTION IN 1934 SHOWS INCREASE

The total value of the mineral production of California for the year 1934, just closed is conservatively estimated by the statistical division, to have been approximately $254,918,000. This is in part, detailed in the tabulation below, but as there are more than 50 mineral substances on California's commercial list, it is impracticable at this early date to obtain definite figures on other than the more important items. The blank report forms are being mailed to the operators in all mineral lines, and the detailed and complete report will be compiled and published later.

The estimated total of $254,918,000 is an increase of aproximately $48,428,000 over the value of the 1933 production, which was valued at $206,489,058. The largest increases in value of outputs over the previous year were shown by petroleum, gold and cement; with lesser increases by silver, quicksilver, miscellaneous industrial minerals, and salines. The only important mineral substances which show decreased production and value are brick and hollow building tile, and copper.

The value of the petroleum output showed a marked increase, although the quantity of about 174,996,000 barrels was an increase of only 0.6% over that of 1933. The prices of all grades of crude oil did not vary during the year, though the average was much higher than that of 1933.

Receipts of buillion at the mint, and smelters showed an increased output of gold of some 77,000 fine ounces over 1933. The value of gold in 1934 was $35 a fine ounce, compared with an average weighted value of $25.56 for 1933 and $20.67 previous to 1933.

The structural group showed an increase owing to an increased output of cement, although the value per barrel was somewhat lower. This increase might be accounted for by the large amount of Public Works' construction in progress during the year. Both the industrial and saline groups trend was for increased values.

The estimated value and quantities for 1934 are as follows:

$24,500,000	gold (700,000 fine ozs).
510,000	(790,000 fine ozs.) silver.
40,000	(500,000 lbs.) copper.
31,000	(850,000 lbs.) lead.
469,000	(5,900 flasks) quicksilver.
26,000	(600,000 lbs.) zinc.
80,000	other metals, including chronium, molybdenum, and tungsten ores, and platinum.
180,246,000	(179,996,000 bbls.) petroleum.
15,291,000	(270,646,000 M cu. ft.) natural gas.
12,075,000	(8,750,000 bbls.) cement.
7,000,000	crushed rock, sand and gravel.
1,450,000	brick and hollow building tile.
700,000	other structural materials, including bituminous rock, granite, magnesite, marble, slate, etc.
3,800,000	miscellaneous industrial minerals.
8,700,000	salines, including borates, potash, salt, soda, etc.
$254,918,000	

MUSEUM

The Museum of the State Division of Mines possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other States and foreign countries as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Division of Mines as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Beside its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the State and to San Francisco.

LABORATORY

Frank Sanborn, Mineral Technologist

The laboratory of the Division of Mines is maintained for the purpose of identifying minerals and making qualitative analyses of rocks. These determinations and analyses are made without cost to those who seek the services of this State department. Ordinarily, a small sample weighing not over half a pound, in the lump form if possible, should be submitted with a letter stating what particular tests are desired, if there is a special reason for sending the material. Not more than three samples should be sent at one time, nor is it necessary to send more than one. Information regarding the size of the deposit and its proximity to rail transportation is useful in determining the possible value of a mineral body.

When requested, assistance in finding a market for a mineral will be given. When such help is desired, a small representative sample of the material for which a market is sought should accompany the request. The Division is sometimes able to send a very small sample of a particular mineral for comparative purposes to any earnest prospector. Prospecting and exploitation of the State's mineral wealth increases as the State becomes more thickly populated. Each year new occurrences of some mineral in the State are reported and occasionally a new mineral species is found. New uses for a mineral are frequently found, and as a result stimulus is given to searching for that particular substance.

LIBRARY

Herbert A. Franke, Librarian

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the Division of Mines contains over six thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of Federal and State governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, California Journal of Mines and Geology contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and State maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED

Governmental, National.

U. S. Geological Survey:
  Bulletins:
    857E—Core Drilling for Coal in the Moose Creek Area, Alaska. By G. A. Waring.
    864A—Mineral Industry of Alaska in 1933. By P. S. Smith.
  Professional Papers:
    185A—Studies of the Alkalinity of Some Silicate Minerals. By R. E. Stevens.
    185D—A Flora of Pottsville Age from the Mosquito Range, Colorado. By C. B. Read.
    185F—A Lower Lance Florule From Harding Co., So. Dakota. By E. W. Berry.
    185G—Halloysite and Allophane. By Ross & Kerr.
U. S. Bureau of Mines:
  Bulletins:
    379—Applied Methods and Equipment for Reducing Evaporation Losses of Petroleum and Gasoline. By L. Schmidt.
  Monograph 5—Gas, Coke-, and By-product-Making Properties of American Coals and Their Determination. By A. C. Fieldner & J. D. Davis.
  Minerals Yearbook, 1934.
  Statistical Appendix to Minerals Yearbook, 1932–1933.

Report of Investigations:

3242—Progress Reports, Metallurgical Division, 7. Studies in Lead Metallurgy. By Geo. L. Oldright and Virgil Miller.
3252—Tabulated Analyses of Texas Crude Oils. By Gustav Wade.
3253—Analyses of Crude Oils from Some Fields of So. Louisiana. By A. J. Kraemer and E. L. Garton.
3255—Lag, Spread, and Sustained Ignition in Electric Detonators. By A. B. Hooker and E. J. Coggeshall.
3257—Production of Explosives in the U. S. during the Calendar year, 1933. By W. W. Adams, E. V. Walters and V. E. Erwin.
3258—Isolation and Study of the Humic Acids from Peat. By Chester L. Arnold, Alexander Lowy, and Reinhardt Thiessen.
3260—Investigations During 1933 of Combustibles in Manholes in Boston, Mass. By G. W. Jones, John Campbell and F. M. Goodwin.
3261—Use of Rock-Dust in Bituminous-Coal Mines During 1930, 1931, and 1932 (A Statistical Survey). By W. W. Adams.

Information Circulars:

6786—Placer Mining in the Western United States. Part I. General Information, Hand-Shoveling and Ground-Sluicing. By E. D. Gardner and C. H. Johnson.
6792—Trends in Practice and Costs of Concentrating Copper Ores. By T. G. Chapman.
6794—Consumption and Prices of Nonmetallic Minerals. By Paul M. Tyler.
6798—Sand and Gravel Excavation: Part 1. The Power Shovel, The Drag-Line Excavator, and the Excavator Crane. By J. R. Thoenen.
6799—Mining Methods and Costs at Herron and Laster Lease, Superior, Ariz. By E. D. Gardner.
6801—Explosions in Indiana Coal Mines, 1878 to 1933. By C. A. Herbert.
6802—Coal Mine Explosions in West Virginia, 1883–1933. By J. J. Forbes and C. W. Owings.
6804—Mining Methods and Costs at El Potosi Mine, El Potosi Mining Co., Chihuahua, Mexico. By Harlan A. Walker.
6805—The Explosion and Fire Hazards of Hydrocarbon-Carbon Tetra-Chloride Mixtures. By G. W. Jones and R. E. Kennedy.
6808—Natural Gasoline Plants in the United States, Jan. 1, 1934. By G. R. Hopkins and E. M. Seeley.
6809—Coal-Mine Fatalities in Kentucky in 1931, 1932, and 1933. By Joseph F. Davies and H. B. Humphrey.
6810—Progress in Safety in Coal Mining in the United States. By D. Harrington.
6811—Safety in Mining in 1933. By D. Harrington.
6812—Safety Conditions in Liberty Mine, Liberty Fuel Co., Latuda, Utah. By D. J. Parker.
6813—Review of Illinois Coal-Mine Fatalities for 1933. By A. U. Miller.

Government, State.

Geological Survey of Alabama, University:
Bulletin No. 42—History and Work of Geological Surveys and Industrial Development in Alabama. By W. B. Jones.

Georgia Division of Geology, Atlanta:
I. C. No. 4—The Gold Deposits of Georgia. By R. A. Wilson.

Idaho Bureau of Mines and Geology, Moscow:
Pamphlet No. 41—Geology of the Pearl-Horseshoe Bend Gold Belt, Idaho. By A. L. Anderson.

Illinois State Geological Survey, Urbana:
R. I. No. 32—Contributions to the Study of Coal.
R. I. No. 34—Contributions to the Study of Coal.
R. I. No. 36—Illinois Mineral Industry in 1933.

Kansas State Geological Survey, Lawrence:
Cephalopods of the Pierre Formation of Wallace Co., Kansas and Adjacent Area. By M. K. Elias.
Development of the Oil and Gas Resources of Kansas. By E. A. Koester.
Kentucky Department of Mines and Minerals, Lexington:
Series VIII, Bulletin 1—Mountain Bumps in the Coal Fields of Harlan Co., Kentucky.

Pennsylvania Geological Survey, Harrisburg:
  Bulletin G 7—Glacial Deposits in Pennsylvania. By F. Leverett.
South Dakota State Geological Survey, Vermillion:
  R. I. No. 17—Water Supplies and Geology of Lake Kampeska. By E. P. Rothrock.
  R. I. No. 21—The Geology of Central Perkins Co., So. Dakota. By W. V. Searight.
  R. I. No. 22—The Stoneville Coal Area. By W. V. Searight.
  R. I. No. 23—Geology of the Crow Creek Dam Site. By E. P. Rothrock.
  R. I. No. 24—A Shallow Water Supply for Huron, So. Dakota. By Rothrock & Petsch.

Government, Foreign.

Alberta Research Council, Edmonton:
  Annual Reports.

Argentina Direccion General de Minas y Geologica, Beunos Aires:
  Publications.

South Australia Department of Mines, Adelaide:
  Annual Reports, Mining Reviews, etc.

Geological Service of Minas Geraes, Bella Horizonte, Brazil:
  Publications.

British Museum of Natural History, London:
  The London Clay Flora. By E. M. Reid and M. E. J. Chandler.

Canada Department of Mines, Ottawa:
  Investigations in Ore Dressing and Metallurgy, January to June, 1933.
  Memoir 173—Slocan Mining Camp, B. C. By C. E. Cairnes.
  Memoir 174—Surface Deposits and Ground-water Supply of Winnipeg Map—area, Manitoba. By W. A. Johnston.

Geological Survey of Great Britain, London:
  Memoirs, Geologic Maps, etc.

Transvaal Chamber of Mines, Johannesburg, So. Africa:
  Publications.

Cuerpo de Ingenieros de Minas y Aguas del Peru, Lima:
  Bulletins.

Secretaria de Industria, Comercio y Trabajo, Mexico, D. F.:
  Boletin Minero.
  Boletin del Petroleo.

Museo de Historia Natural de Montevideo, Uruguay:
  Analas.

New Zealand Geological Survey Branch, Wellington:
  Reports.

Nova Scotia Department of Public Works and Mines, Halifax:
  Annual Reports.

Ontario Department of Mines, Toronto, Canada:
  Publications.

Quebec Bureau of Mines, Quebec, Canada:
  Publications.

Queensland Department of Mines, Brisbane, Australia:
  Annual Reports.
Instituto Historica e Geographico, Rio de Janeiro:
  Publications.

Geological Survey of Scotland:
  Publications.

New South Wales Department of Mines, Sydney, Australia:
  Annual Reports.

Societies and Educational Institutions.

Academia de Ciencias y Artes de Barcelona, Spain:
  Memoiras.

Academy of Natural Sciences of Philadelphia:
  Proceedings.

American Association of Petroleum Geologists, Tulsa, Oklahoma:
Bulletins.

American Geographical Society of New York:
"Geographical Review."

American Journal of Science, New Haven, Conn.

American Philosophical Society, Philadelphia:
Proceedings.

Australian Museum, Sydney.
Records.

California Academy of Sciences, San Francisco:
Proceedings.

Canadian Institute of Mining and Metallurgy, Montreal:
"Canadian Mining and Metallurgical Bulletin."

Carnegie Institution of Washington:
No. 415—A Pleistocene Flora from Santa Cruz Island, California. By R. W. Chaney and H. L. Mason.

Cleveland Museum of Natural History, Cleveland, Ohio:
Scientific Publications.

Colorado College Publication, Colorado Springs.

Colorado Scientific Society, Denver:
Proceedings.

Commonwealth Club, San Francisco:
Journals.

Economic Geology, Lancaster, Pa.

Field Museum of Natural History, Chicago:
Geological Series.

Franklin Institute of the State of Pennsylvania, Lancaster, Pa.:
Journals.

Geological Society of America, Columbia University, New York:
Bulletins.

Geographical Society of London:
Abstracts of the Proceedings.

Institution of Mining and Metallurgy, London:
Bulletins, Transactions.

Instituto Geologico de Mexico, Mexico, D. F.:
Bulletins.

Journal of Geology, Chicago.
Library of Congress, Washington, D. C.:
Monthly Check List of State Publications.

Mineralogical Society of America, Menasha, Wisconsin:
"The American Mineralogist."

Michigan College of Mining and Technology, Houghton:
Vol. 8, No. 2—Some Recent Methods of Seismic and Electrical Prospecting.
Mining and Metallurgical Society of America, New York:
Bulletins.

Museu Nacional, Rio de Janeiro:
Boletins.

National Research Council, Washington, D. C.:
Transactions of the American Geophysical Union for 1932, 1933 and 1934.

New York Academy of Sciences, New York:
Annals, etc.

New York State Museum, Albany:
Publications.

Northwest Scientific Association, Cheney, Wash.:
"Northwest Science."

Pennsylvania State College, State College:
Bulletins.

Philippine Journal of Science, Manila.

Royal Society of South Australia, Adelaide:
  Transactions and Proceedings.

Seismological Society of America, Stanford University:
  Bulletins.

Sierra Club, San Francisco:
  Bulletins.

Society of Economical Paleontologists and Mineralogists, Ft. Worth, Texas:
  "Journal of Paleontology."

Southern California Academy of Sciences, Los Angeles:
  Bulletins.

University of California Publications:
  Bulletins of the Department of Geological Sciences, Berkeley.
  Vol. 23, No. 8—A correlation of Some Miocene and Pliocene Mammalian Assemblages in North America and Asia with a Discussion of the Mio-Pliocene Boundary. By de Chardin & Stirton.

Books.

The Challenge to Liberty. By Herbert Hoover.
Metal Quarry Catalogs.
The Natural Wealth of California, 1868. By T. F. Cronise.
Nickel, Past and Present. By R. C. Stanley.
Petroleum, Facts and Figures—First, Second, Third and Fourth Editions. By American Petroleum Institute.

John Hays Hammond Public Mining Library:
  Ores and Industry in South America. By Bain and Read.

Maps.

U. S. Geological Survey Topographic

  Arizona:
    Ajo Quadrangle.
  California:
    Coal Oil Canyon Quadrangle, Kern Co.
    Llano Quadrangle, Los Angeles Co.
    Lokern Quadrangle, Kern Co.

  Missouri:
    Bloomfield Quadrangle.
    Morley Quadrangle.
    Puxico Quadrangle.
    Thebes Quadrangle.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
California Journal of Development, San Francisco.
California Mining Journal, Auburn.
California Oil World, Los Angeles.
California Safety News, San Francisco.
Canadian Mining Journal, Gardenvale, Quebec.
Chemical and Metallurgical Engineering, New York City.
Chemical Engineering and Mining Review, Melbourne, Australia.
Commonwealth, San Francisco.
Colorado School of Mines, Golden, Colorado.
Engineering and Mining Journal, New York City.
Fuel Oil, Chicago, Illinois.
Fusion Facts, Whittier, California.
Geophysical Prospector, Los Angeles.
Grizzly Bear, Los Angeles.
Hercules Mixer, Wilmington, Delaware.
Independent Monthly, Tulsa, Oklahoma.

Lubrication, The Texas Co., New York City.
Metals and Alloys, Pittsburgh, Pa.
Mineralogist, Portland, Ore.
Mining Congress Journal, Washington, D. C.
Mining Journal, London.
Mining Journal, Phoenix, Arizona.
Mining and Metallurgy, New York City.
Mining Review, Salt Lake City.
National Sand and Gravel, Washington, D. C.
Nickel Cast Iron News, New York City.
Northwest Mining, Spokane, Washington.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil, Paint and Drug Reporter, New York City.
Oil Weekly, Houston, Texas.
Pacific Purchaser, San Francisco.
Petroleum World, Los Angeles.
Pit and Quarry, Chicago.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago.
Rocks and Minerals, Peekskill, New York.
Scientific American, New York City.
Southwest Builder and Contractor, Los Angeles.
Stabilizer, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York City.
Western Mining News, San Francisco.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, California.
Banner, Sonora, California.
Barstow Printer, Barstow, California.
Bridgeport Chronicle-Union, Bridgeport, California.
Calaveras Californian, Angels Camp, California.
Calaveras Prospect, San Andreas, California.
Daily Commercial News, San Francisco, California.
Daily Midway Driller, Taft, California.
Del Norte Triplicate, Crescent City, California.
Denver Mining Record, Denver, Colorado.
Georgetown Gazette, Georgetown, California.
Inland Oil Index, Casper, Wyoming.
Inyo Independent, Independence, California.
Inyo Register, Bishop, California.
Las Vegas Age, Las Vegas, Nevada.
Livermore Herald, Livermore, California.
Mariposa Gazette, Mariposa, California.
Mercury Register, Oroville, California.
Mining & Industrial News, San Francisco, California.
Mojave Miner, Kingman, Arizona.
Mojave-Randsburg Record, Mojave, California.
Morning Union, Grass Valley, California.
Mountain Messenger, Downieville, California.
Needles Nugget, Needles, California.
Nevada City Nugget, Nevada City, California.
Nevada Mining Bulletin, Las Vegas, Nevada.
Oil Marketer, Bayonne, New Jersey.
Placer Herald, Auburn, California.
Plumas Independent, Quincy, California.
San Diego News, San Diego, California.
Shasta Courier, Redding, California.
Siskiyou News, Yreka, California.
Stockton Record, Stockton, California.
Tehachapi News, Tehachapi, California.
Terra Bella News, Terra Bella, California.
Tuolumne Independent, Sonora, California.
Tuolumne Prospector, Tuolumne, California.
Union Democrat, Sonora, California.
Ventura County News, Ventura, California.
Waterford News, Waterford, California.
Weekly Trinity Journal, Weaverville, California.
Western Mineral Survey, Salt Lake City, Utah.
Western Sentinel, Etna Mills, California.

PRODUCERS AND CONSUMERS

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by this Division to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of *Mining in California* was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of CALIFORNIA JOURNAL OF MINES AND GEOLOGY, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes,' and sent to those on the mailing list of CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

EMPLOYMENT SERVICE

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

Technical men, or those qualified for supervisory positions, and vacancies of like nature only, are registered, as no attempt will be made to supply common mine and mill labor.

Registration cards for the use of both prospective employers and employees may be obtained upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded. Parties interested should communicate direct with our San Francisco office.

PUBLICATIONS OF THE DIVISION OF MINES

During the past fifty-four years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the State, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have usually been limited, the reports and bulletins mentioned are printed in limited editions many of which are now entirely exhausted.

Copies of such publications are available, however, in the offices of the Division of Mines, in the Ferry Building, San Francisco; State Building, Los Angeles; State Office Building, Sacramento; Redding; and Division of Oil and Gas at Santa Barbara, Santa Paula, Coalinga, Taft, Bakersfield. They may also be found in many public, private and technical libraries in California and other States and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

Money orders should be made payable to the Division of Mines.

NOTE.—The Division of Mines frequently receives requests for some of the early Reports and Bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

REPORTS

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----	----
Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	$0.50	$0.10
Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	.50	.10
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----	----
Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	1.00	.15
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	1.00	.20
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:		
Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	.50	.10
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50	.10
Mines and Mineral Resources, Del Norte, Humboldt and Mendocino Counties, 59 pp., paper	.25	.10
Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pp., paper	.50	.10
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.35	.10
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----	----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915: A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou and Trinity Counties, 974 pp., 275 illustrations, cloth	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916. Fletcher Hamilton:		
Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	.65	.10
Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties, 91 pp., paper	.50	.05
Mines and Mineral Resources, El Dorado, Placer, Sacramento and Yuba Counties, 198 pp., paper	.65	.10
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara and Ventura Counties, 183 pp., paper	.65	.10
Mines and Mineral Resources, Los Angeles, Orange and Riverside Counties, 136 pp., paper	.50	.10
Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	.65	.10

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**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917: A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1917–1918, Fletcher Hamilton:		
Mines and Mineral Resources of Nevada County, 270 pp., paper	$0.75	$0.15
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50	.10
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50	.10
Seventeenth Report of the State Mineralogist, 1920, 'Mining in California during 1920,' Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75	.25
Eighteenth Report of the State Mineralogist, 1922, 'Mining in California,' Fletcher Hamilton. Chapters published monthly beginning with January, 1922:		
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Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	.25	.05
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy	.25	.05
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
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July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego Counties	.25	.10
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Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
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**October, 1926, Mines and Mineral Resources of El Dorado and Inyo Counties, also report on Minaret District, Madera County	----	----
Chapters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
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Chapters of Twenty-fifth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
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April, 1929, Mines and Mineral Resources of Sierra, Napa, San Francisco and San Mateo Counties	$0.25	$0.10
July, 1929, Mines and Mineral Resources of Colusa, Fresno and Lake Counties	.25	.10
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Chapters of Twenty-sixth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
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July, 1930, Mines and Mineral Resources of Yuba and San Bernardino Counties; also Commercial Grinding Plants in California	.25	.10
October, 1930, Mines and Mineral Resources of Butte, Kings and Tulare Counties; also Geology of Southwestern Mono County (Preliminary)	.25	.10
Chapters of Twenty-seventh Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1931, Preliminary Report on Economic Geology of the Shasta Quadrangle. Beryllium and Beryl. The New Tariff and Nonmetallic Products. Crystalline Talc. Decorative Effects in Concrete	.25	.10
April, 1931, Stratigraphy of the Kreyenhagen Shale. Diatoms and Silicoflagellates of the Kreyenhagen Shale. Foraminifera of the Kreyenhagen Shale. Geology of Santa Cruz Island	.25	.10
July, 1931. (Yuba, San Bernardino.) Feldspar, Silica, Andalusite and Cyanite Deposits of California. Note on a Deposit of Andalusite in Mono County; its occurrence and chemical importance. Bill creating Trinity and Klamath River Fish and Game District and its effect upon mining	.25	.10
October, 1931. (Alpine.) Geology of the San Jacinto Quadrangle south of San Gorgonio Pass, California. Notes on Mining Activities in Inyo and Mono Counties in July, 1931	.25	.05
Chapters of Twenty-eighth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1932, Economic Mineral Deposits of the San Jacinto Quadrangle. Geology and Physical Properties of Building Stone from Carmel Valley. Contributions to the Study of Sediments. Sediments of Monterey Bay. Sanbornite	.25	.10
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Abstract from April quarterly: Elementary Placer Mining Methods and Gold Saving Devices. Types of Deposits. Simple Equipment. Special Machines. Dry Washing. Black Sand Treatment. Marketing of Products. Placer Mining Areas. Laws. Prospecting for Quartz Veins. Bibliography (mimeographed)	.20	.05
July-October. (Ventura.) Report accompanying Geologic Map of Northern Sierra Nevada. Fossil Plants in Auriferous Gravels of the Sierra Nevada. Glacial and Associated Stream Deposits of the Sierra Nevada. Jurassic and Cretaceous Divisions in the Knoxville-Shasta Succession of California. Geology of a Part of the Panamint Range. Economic Report of a Part of the Panamint Range. Acquiring Mining Claims Through Tax Title. The Biennial Report of State Mineralogist	.50	.15
Chapters of Report XXIX, 1933 (quarterly): titled "California Journal of Mines and Geology," containing the following:		
January-April. Gold Deposits of the Redding and Weaverville Quadrangles. Geologic Formations of the Redding-Weaverville District, Northern California. Geology of Portions of Del Norte and Siskiyou Counties. Applications of		

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July-October. Gold Resources of Kern County. Limestone Deposits of the San Francisco Region. Limestone Weathering and Plant Associations of the San Francisco Region. Booming. Death Valley National Monument, California. Placer Mining Districts, Senate Bill 480. Navigable Waters, Assembly Bill 1543	.80	.10
Chapters of Report XXX, 1934 (quarterly): titled "California Journal of Mines and Geology," containing the following:		
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**Bulletin No. 10. A bibliography Relating to the Geology, Paleontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp	----	----
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Bulletin No. 109. California Mineral Production and Directory of Mineral Producers for 1932, by Henry H. Symons, 200 pp. paper	.25	.10
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**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin, 4 pp.	----	----
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**Preliminary Report No. 6. A Review of Mining in California During 1919. By Fletcher Hamilton, 1920. 43 pp. Paper	----	----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper	----	----
**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. By Fletcher Hamilton, 1922. 68 pp. Paper	----	----

MISCELLANEOUS PUBLICATIONS

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper	----	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper	$0.10	----
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923	Free	.15 annually

MAPS

Register of Mines With Maps

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
Register of Mines, with Map, Amador County	$0.25	$0.05
Register of Mines, with Map, Butte County	.25	.05
**Register of Mines, with Map, Calaveras County	----	----
**Register of Mines, with Map, El Dorado County	----	----
**Register of Mines, with Map, Inyo County	----	----
**Register of Mines, with Map, Kern County	----	----
**Register of Mines, with Map, Lake County	----	----
**Register of Mines, with Map, Mariposa County	----	----
**Register of Mines, with Map, Nevada County	----	----
**Register of Mines, with Map, Placer County	----	----
**Register of Mines, with Map, Plumas County	----	----
**Register of Mines, with Map, San Bernadino County	----	----
Register of Mines, with Map, San Diego County	.25	.05
Register of Mines, with Map, Santa Barbara County (1906)	.25	.05
**Register of Mines, with Map, Shasta County	----	----
**Register of Mines, with Map, Sierra County	----	----
**Register of Mines, with Map, Siskiyou County	----	----
**Register of Mines, with Map, Trinity County	----	----
**Register of Mines, with Map, Tuolumne County	----	----
Register of Mines, with Map, Yuba County (1905)	.25	.05
Register of Oil Wells, with Map, Los Angeles City (1906)	.35	.05

OTHER MAPS

**Map of California, Showing Mineral Deposits (50 x 60 in.)	----	----
**Map of Forest Reserves in California	----	----
**Mineral and Relief Map of California	----	----
**Map of El Dorado County, Showing Boundaries, National Forests	----	----
**Map of Madera County, Showing Boundaries, National Forests	----	----
**Map of Placer County, Showing Boundaries, National Forests	----	----
**Map of Shasta County, Showing Boundaries, National Forests	----	----
**Map of Sierra County, Showing Boundaries, National Forests	----	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----	----
**Map of Mother Lode Region	----	----
**Map of Desert Region of Southern California	----	----
Map of Minaret District, Madera County	.20	.05
Map of Copper Deposits in California	.05	----
**Map of Calaveras County	----	----
**Map of Plumas County	----	----
**Map of Trinity County	----	----
**Map of Tuolumne County	----	----
Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60	.05
**Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	----	----
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Unmounted	.75	.05
Mounted	2.50	.15
**Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels, accompanying Bulletin No. 92. In 4 colors (also sold singly)	----	----

OTHER MAPS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
Geologic Map of Northern Sierra Nevada, showing Tertiary River Channels and Mother Lode Belt, accompanying July-October Chapter of Report XXVIII of the State Mineralogist. (Sold singly)	$0.25	$0.05
Map of Northern California, showing rivers and creeks which produced placer gold in 1932	.20	.05
Mother Lode Geologic and claim maps in 5 county sections: El Dorado, Amador, Calaveras, Tuolumne and Mariposa. Single sections 10c. Set of 5	.50	----
Map of Mariposa County showing principal gold mines	.10	----

OIL FIELD MAPS

The maps are revised from time to time as development work advances and ownerships change.

	Price (including postage)
Map No. 1—Sargent, Santa Clara County	$0.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	1.00
Map No. 3—Santa Maria, including Casmalia and Lompoc	1.00
Map No. 4—Brea Olinda & (East Portion) Coyote Hills, Los Angeles and Orange Counties	1.00
Map No. 6—Salt Lake-Beverly Hills, Los Angeles County	1.00
Map No. 7—Sunset and San Emidio, Kern County	1.00
Map No. 8—South Midway and Buena Vista Hills, Kern County	1.00
Map No. 9—North Midway and McKittrick, Kern County	1.00
Map No. 10—Belridge and McKittrick Front, Kern County	1.00
Map No. 11—Lost Hills and North Belridge, Kern County	1.00
Map No. 12—Devils Den, Kern County	.75
Map No. 13—Kern River and Fruitvale, Kern County	1.00
Map No. 14—Coalinga, Fresno County	1.25
Map No. 15—Elk Hills, Kern County	1.00
Map No. 16—Ventura-Ojai, Ventury County	1.00
Map No. 17—Santa Paula–Sespe, including Bardsdale, South Mountain and Camarillo, Ventura County	1.00
Map No. 18—Piru-Simi-Newhall, Ventura County	1.00
Map No. 19—Arroyo Grande, San Luis Obispo County	.75
Map No. 20—Long Beach, Los Angeles County	1.50
Map No. 21—Portion of District No. 4, showing boundaries of oil fields—Kern and Kings Counties	.75
Map No. 21-A—Portion of District No. 4, showing boundaries of oil fields—Kern County	.75
Map No. 21-B—Portion of District No. 5, showing boundaries of oil fields—Fresno, Kings and Kern Counties	.75
Map No. 22—Portion of District No. 3, showing boundaries of oil fields—Santa Barbara County	.75
Map No. 23—Portion of District No. 2, showing boundaries of oil fields—Ventura County	.75
Map No. 24—Portion of District No. 1, showing boundaries of oil fields—Los Angeles and Orange Counties	1.00
Map No. 26—Huntington Beach, Orange County	1.25
Map No. 27—Santa Fe Springs, Los Angeles County	1.00
Map No. 28—Torrance, Los Angeles County	1.00
Map No. 29—Dominguez, Los Angeles County	.75
Map No. 30—Rosecrans, Los Angeles County	.75
Map No. 31—Inglewood, Los Angeles County	1.00
Map No. 32—Seal Beach, Los Angeles and Orange Counties	1.00
Map No. 33—Rincon, Ventura County	1.00
Map No. 34—Mt. Poso, Kern County	.75
Map No. 35—Round Mountain, Kern County	.75
Map No. 36—Kettleman Hills, Fresno, Kings and Kern Counties	1.25
Map No. 37—Montebello, Los Angeles County	1.00
Map No. 38—Whittier, Los Angeles County	1.00
Map No. 39—West Coyote, Los Angeles and Orange Counties	1.00
Map No. 40—Elwood, Santa Barbara County	1.00
Map No. 41—Potrero, Los Angeles County	.75
Map No. 42—Playa del Rey, Los Angeles County	1.25
Map No. 43—Capitan, Santa Barbara County	.75
Map No. 44—Mesa, Santa Barbara County	1.25
Map No. 45—Buttonwillow gas, Kern County	.75
Map No. 46—Richfield, Orange County	1.00
Map No. 47—Mountain View, Kern County	.75
Map No. 48—Mountain View and Edison, Kern County	1.25

DETERMINATION OF MINERAL SAMPLES

Samples (limited to one at one time) of any mineral found in the State may be sent to the Division of Mines for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the State. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

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STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES

DIVISION OF MINES

CORDIALLY INVITES YOU TO VISIT
ITS VARIOUS DEPARTMENTS MAINTAINED
FOR THE PURPOSE OF FURTHERING
THE DEVELOPMENT OF THE

MINERAL RESOURCES OF CALIFORNIA

At the service of the public are the scientific reference library and reading room, the general information bureau, the laboratory for the free determination of mineral samples found in the State, and the largest museum of mineral specimens on the Pacific Coast. The time and attention of the State Mineralogist, as well as that of his technical staff, are also at your disposal.

Office hours: 9 a.m. to 5 p.m. daily.
Saturday, 9 a.m. to 12 m.
(Except July and August, 8 a.m. to 4 p.m.)

WALTER W. BRADLEY,
State Mineralogist.

Third floor, Ferry Building, San Francisco, Cal. Branch Offices: State Building, Los Angeles; State Office Building, Sacramento; Chamber of Commerce, Redding; Bank of Italy Building, Bakersfield; San Marcos Building, Santa Barbara; Taft, Coalinga and Santa Paula.

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
GEORGE D. NORDENHOLT, Director

DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO

WALTER W. BRADLEY State Mineralogist

Vol. 31 APRIL, 1935 No. 2

CALIFORNIA JOURNAL
OF
MINES AND GEOLOGY

QUARTERLY CHAPTER
OF
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SACRAMENTO, 1935

22920

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State Mineralogist

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PREFACE

The Division of Mines (formerly State Mining Bureau) is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

As a progressive step in advancing the interests of the mineral industry, and as permitting earlier distribution to the public, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923. Owing to a lack of funds for printing this was changed to a quarterly publication, beginning in September, 1923. For the same reason, beginning with the January, 1924, issue, it became necessary to charge a subscription price. This covers approximately the cost of printing.

Pages are numbered consecutively throughout the year and an index to the complete report is included annually in the closing number.

Beginning with the 1930 issues, the activities and progress of the Geologic Branch are recorded also in these quarterly chapters. The important part that geology plays in the economic development of our mineral resources is further recognized in the change of title from *Mining in California* to CALIFORNIA JOURNAL OF MINES AND GEOLOGY, beginning with the January, 1933, chapter.

While current activities of all descriptions are covered in these chapters, the practice of issuing from time to time technical reports on special subjects will be continued as well. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters are subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Division of Mines is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

Types of Reports

In general the reports presented in these chapters are grouped into three classes:

1. Mines and mineral resources of a given county (describing kind, character, distribution and extent of development).
2. Specific economic and industrial mineral products (listing and describing the resources over the entire State of a given mineral substance, e.g. feldspar).
3. Geological reports on specific areas (recording results and conclusions, with maps, derived from field studies; and tied in with economic possibilities, and developments).

TABLE OF CONTENTS

Page

District Reports of Mining Engineers ... 111
  Redding Field District ... 111
  Sacramento Field District ... 111
  San Francisco Field District ... 111
  Los Angeles Field District ... 111

Geologic Branch ... 112
  Current Notes ... 112
  A Geologic Section Across the Southern Peninsular Range of California ... 115
  New Technique Applicable to the Study of Placers ... 143

Oil Field Development Operations ... 211

Special Articles ... 215
  Grubstake Permits ... 215

Administrative ... 220

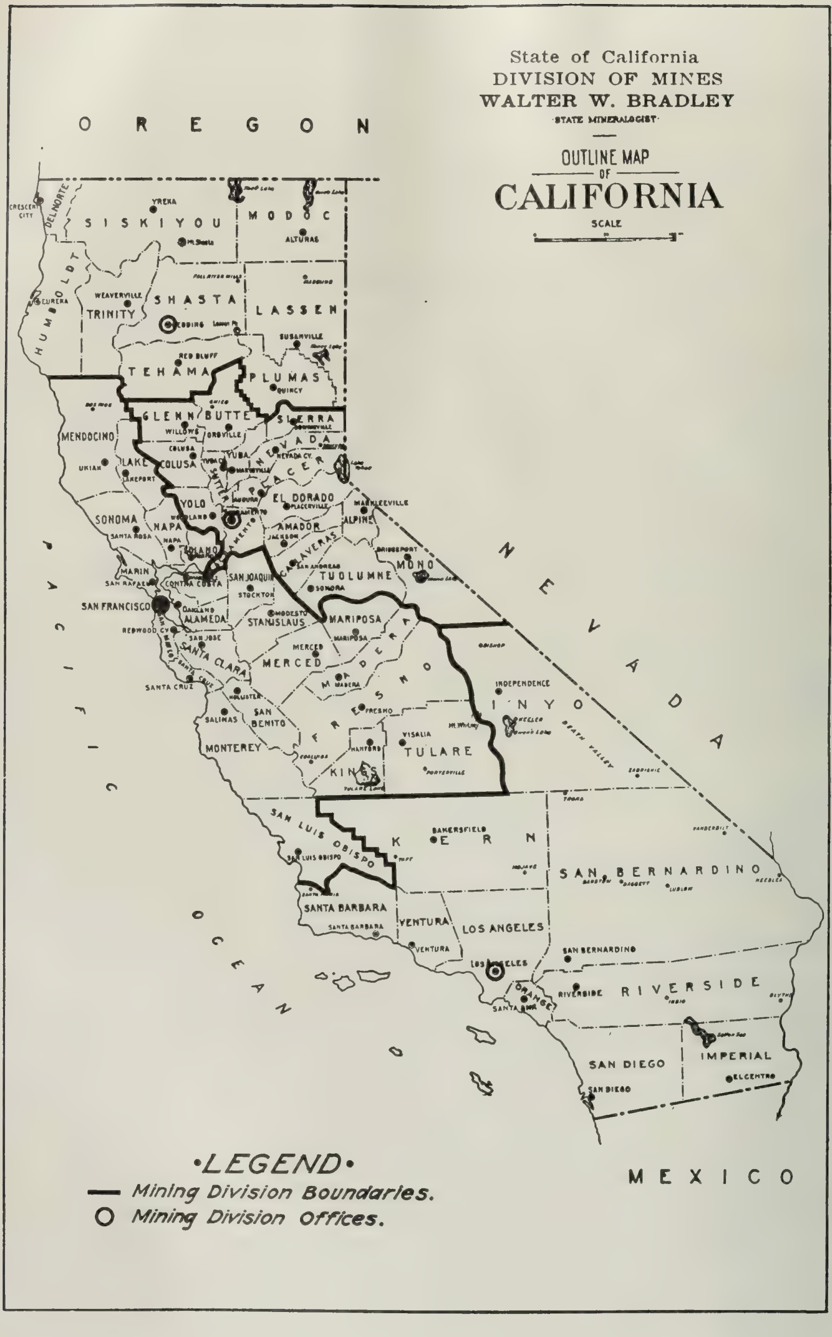
Minerals and Statistics ... 221
  Statistics ... 221
  Museum ... 228
  Laboratory ... 246

Library ... 246

Producers and Consumers ... 253

Employment Service ... 253

Publications ... I



State of California
DIVISION OF MINES
WALTER W. BRADLEY
STATE MINERALOGIST

OUTLINE MAP
OF
CALIFORNIA

SCALE
OREGON
NEVADA
MEXICO
PACIFIC OCEAN
DEL NORTE
CRESCENT CITY
SISKIYOU
YREKA
MT. SHASTA
MODOC
ALTURAS
HUMBOLDT
EUREKA
TRINITY
WEAVERVILLE
SHASTA
REDDING
LASSEN
SUSANVILLE
TEHAMA
RED BLUFF
PLUMAS
QUINCY
MENDOCINO
UKIAH
GLENN
WILLOWS
BUTTE
OROVILLE
CHICO
SIERRA
DOWNIEVILLE
NEVADA
NEVADA CY.
COLUSA
LAKE
LAKEPORT
YUBA
MARYSVILLE
SUTTER
PLACER
AUBURN
EL DORADO
PLACERVILLE
YOLO
WOODLAND
SACRAMENTO
SONOMA
SANTA ROSA
NAPA
SOLANO
AMADOR
JACKSON
ALPINE
MARKLEEVILLE
MARIN
SAN RAFAEL
CONTRA COSTA
SAN FRANCISCO
OAKLAND
ALAMEDA
SAN JOAQUIN
STOCKTON
CALAVERAS
SAN ANDREAS
TUOLUMNE
SONORA
MONO
BRIDGEPORT
STANISLAUS
MODESTO
MARIPOSA
REDWOOD CY.
SAN MATEO
SAN JOSE
SANTA CLARA
SANTA CRUZ
MERCED
MADERA
FRESNO
INYO
INDEPENDENCE
BISHOP
MT. WHITNEY
DEATH VALLEY
HOLLISTER
SAN BENITO
SALINAS
MONTEREY
COALINGA
HANFORD
KINGS
VISALIA
TULARE
PORTERVILLE
SAN LUIS OBISPO
KERN
BAKERSFIELD
TAFT
MOJAVE
SAN BERNARDINO
BARSTOW
DAGGETT
LUDLOW
NEEDLES
VANDERBILT
SANTA MARIA
SANTA BARBARA
VENTURA
LOS ANGELES
ORANGE
SANTA ANA
RIVERSIDE
INDIO
BLYTHE
SAN DIEGO
IMPERIAL
EL CENTRO

•LEGEND•
- Mining Division Boundaries.
- ○ Mining Division Offices.

REPORTS OF DISTRICT MINING ENGINEERS

In 1919–1920 the Mining Bureau was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district, working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively. This move brought the office into closer personal contact with operators, and it has many advantages over former methods of conducting field work, including lower traveling-expense bills for the Bureau's engineers. In 1923 the Redding and Auburn field offices were consolidated and moved to Sacramento.

The Redding office was reestablished in 1928, and the boundaries of each district adjusted. The counties now included in each of the four divisions and the locations of the branch offices are shown on the accompanying outline map of the State. (Frontispiece.)

Reports of mining activities and development in each district, prepared by the District Engineer, will continue to appear under the proper field division heading.

REDDING FIELD DISTRICT

CHAS. V. AVERILL, Mining Engineer

There is no report from the Redding Field Division. Mr. Chas. V. Averill, District Mining Engineer, is engaged on investigations for a special report upon the gold resources of Siskiyou County.

SACRAMENTO FIELD DISTRICT

C. A. LOGAN, Mining Engineer

Mr. C. A. Logan, District Engineer, has completed the preparation of a special report upon the Mother Lode Gold Belt of California, which is now available.

SAN FRANCISCO FIELD DISTRICT

C. McK. LAIZURE, Mining Engineer

Reports covering the mines and mineral resources of all of the counties in the San Francisco field division are now available, and field work at present is confined to investigations for special reports upon various economic minerals.

LOS ANGELES FIELD DISTRICT

W. B. TUCKER and R. J. SAMPSON, Mining Engineers

Reports covering the mines and mineral resources of most of the counties in the Los Angeles field division are now available, and field work at present is confined to investigations for special reports upon various economic minerals.

GEOLOGIC BRANCH

CURRENT NOTES

Olaf P. Jenkins, Chief Geologist

Since very little geologic work has been done in the southernmost part of the state, the following contribution by Dr. W. J. Miller, "A Geologic Section Across the Southern Peninsular Range of California," should attract considerable interest. The strip of country described lies along the main line of travel, and the report with its accompanying map should therefore serve as a guide to the mineral-minded tourist.

Sometimes technical methods of research reach a high degree of perfection, but are not applied where they serve the most useful purposes. "New Technique Applicable to the Study of Placers" describes improved methods of exploration of gold placers in the special and extremely interesting geologic setting of California.

The geologic history of California is well chronicled by rock formations of all sorts, exposed under many differing conditions. Since the legend of the new geologic map of California, now well advanced in its preparation, tells much of the historical sequence and character of the rock groups found in the state, and since a point has been reached where further compilation is impossible without added field work, it seems advisable to present the assembled map legend, so that it may be available as a guide for further research. In order to coordinate the geology with the deposits of commercial minerals in the state, another map has also been started, to be drawn on the same base as the state geologic map, scale 1:500,000. This map will show accurately the location of the principal deposits of commercial and unusual minerals. Both of these maps will be closely coordinated and will have descriptive reports accompanying them.

PRELIMINARY LEGEND
OF
ROCK FORMATION UNITS USED
ON THE
NEW GEOLOGIC MAP OF CALIFORNIA

(Not yet published)

Scale of Map—1:500,000

(Cooperative project, United States Geological Survey and
California State Division of Mines.)

The name of each geologic unit used on the map is given below in italics following its corresponding symbol which, together with a special color and pattern, show very distinctly on the map the areal distribution of the rocks. The units are, in general, groupings of formations which elsewhere in special reports have been mapped separately on more detailed sheets.

- CENOZOIC
  - QUATERNARY
    - RECENT
      - Nonmarine
        - (Qal) *Alluvium*
        - (Qs) *Sand dunes*
      - Volcanic
        - (Qrv) *Recent volcanics*
          - (Qrv^{r}) *Recent rhyolite*
          - (Qrv^{a}) *Recent andesite*
          - (Qrv^{b}) *Recent basalt*
        - (Qmf) *Volcanic mud flows*
          Cinder cones
    - PLEISTOCENE
      - Marine
        - (Qm) *Pleistocene marine sediments*
      - Nonmarine
        - (Ql) *Pleistocene lake beds*
        - (Qt) *Terrace deposits*
        - (Qg) *Glacial deposits*
      - Volcanic
        - (Qv) *Quaternary volcanics*
          - (Qv^{r}) *Quaternary rhyolite*
          - (Qv^{a}) *Quaternary andesite*
          - (Qv^{b}) *Quaternary basalt*
  - QUATERNARY-PLIOCENE
    - Marine and Nonmarine
      - (QP) *Quaternary and upper Pliocene sediments*
    - Volcanic
      - (TQv) *Cenozoic volcanics*
  - TERTIARY
    - PLIOCENE
      - Marine
        - (Pu) *Upper Pliocene marine sediments*
        - (Pml) *Middle and lower Pliocene marine sediments*
      - Nonmarine
        - (Puc) *Upper Pliocene nonmarine sediments*
        - (Pc) *Undifferentiated Pliocene nonmarine sediments*
      - Volcanic
        - (Pv) *Pliocene volcanics*
          - (Pv^{r}) *Pliocene rhyolite*
          - (Pv^{a}) *Pliocene andesite*
          - (Pv^{b}) *Pliocene basalt*
        - (Pvl) *Lower Pliocene volcanics and interbedded sediments*
    - MIOCENE
      - Marine
        - (Mu) *Upper Miocene marine sediments*
        - (Mm) *Middle Miocene marine sediments*
        - (Ml) *Lower Miocene marine sediments*
      - Nonmarine
        - (Muc) *Upper Miocene nonmarine sediments*
        - (Mmc) *Middle Miocene nonmarine sediments*
        - (Mc) *Undifferentiated Miocene nonmarine sediments*
      - Volcanic
        - (Mv) *Miocene volcanics*
          - (Mv^{r}) *Miocene rhyolite*
          - (Mv^{a}) *Miocene andesite*
          - (Mv^{b}) *Miocene basalt*
    - OLIGOCENE
      - Marine and Nonmarine
        - (Ø) *Oligocene sediments*

- EOCENE
  - Marine
    - (Eu) *Upper Eocene marine sediments*
    - (El) *Lower Eocene marine sediments*
  - Nonmarine
    - (Euc) *Upper Eocene nonmarine sediments*
- UNDIFFERENTIATED TERTIARY
    - (Tlb) *Tertiary lake beds*
    - (Tg) *Auriferous gravels*
  - Volcanic
    - (Ti) *Tertiary intrusives*
    - (Tv) *Undifferentiated Tertiary volcanics*
      - (Tv^r) *Tertiary rhyolite*
      - (Tv^a) *Tertiary andesite*
      - (Tv^b) *Tertiary basalt*

MESOZOIC

- CRETACEOUS
  - Marine
    - (K) *Undifferentiated Cretaceous marine sediments*
      - (Kc) *Upper Cretaceous marine sediments*
      - (Ks) *Lower Cretaceous marine sediments*

NOTE.—Below this point many of the rocks are regionally intensely metamorphosed, especially those of the older formations, whereas above this point the rocks have not in general suffered such change of character by metamorphism.

- JURASSIC
  - Marine
    - (JK) *Knoxville formation*
    - (Ju) *Upper Jurassic marine sediments*
    - (Jml) *Middle and lower Jurassic marine sediments*
    - (Jf) *Franciscan group (undifferentiated)*
  - Igneous rocks (largely intrusive)
    - (Jai) *Jurassic acid intrusives*
    - (grd) *Undifferentiated granitic rocks*
    - (Jbi) *Jurassic basic igneous rocks*
    - (Jub) *Jurassic ultra-basic intrusives*
- JURA-TRIAS
  - Meta-volcanics
    - (JTv) *Jura-Trias volcanics*
- TRIASSIC
  - Marine
    - (TR) *Triassic marine sediments*

PALEOZOIC

- CARBONIFEROUS
  - Marine
    - (Cp) *Pennsylvania and Permain marine sediments*
    - (Cm) *Mississippian marine sediments*
    - (C) *Undifferentiated Carboniferous marine sediments*
  - Volcanic
    - (Cv) *Carboniferous volcanics*
- DEVONIAN
  - Marine
    - (D) *Devonian marine sediments*
- SILURIAN
  - Marine
    - (S) *Silurian marine sediments*
- ORDOVICIAN
  - Marine
    - (O) *Ordovician marine sediments*
- CAMBRIAN
  - Marine
    - (-C) *Cambrian marine sediments*

PROTEROZOIC

- ALGONKIAN
    - (A) *Algonkian rocks*
- ARCHEAN
    - (AR) *Archean rocks*

UNDIFFERENTIATED PRE-CRETACEOUS ROCKS

- Largely meta-sedimentary
  - (pK) *Undifferentiated pre-Cretaceous metamorphics*
  - (pfs) *Undifferentiated pre-Franciscan sediments*
  - (p-C) *Pre-Cambrian metamorphics*
- Meta-igneous
  - (pDv) *Undifferentiated pre-Devonian volcanics*
  - (P-Ci) *Pre-Cambrian igneous rocks*

A GEOLOGIC SECTION ACROSS THE SOUTHERN PENINSULAR RANGE OF CALIFORNIA

By William J. Miller *

OUTLINE OF REPORT

	Page
ABSTRACT	115
INTRODUCTION	116
Purpose and Scope of the Paper	116
Previous Work	116
GENERAL TOPOGRAPHY AND GEOMORPHOLOGY	118
EARLIER MESOZOIC (?) ROCKS	120
Julian Schist (Triassic?)	120
Age Relations	120
Black Mountain Volcanics (Triassic or Jurassic?)	121
Age Relations	122
Economic Value	122
LATE MESOZOIC (?) PLUTONIC ROCKS	123
Viejas Gabbro-diorite	123
Age Relations	124
Alpine Quartz Diorite	126
Age Relations	126
Harbison Quartz Diorite	126
Age Relations	127
Descanso Granodiorite	127
Age Relations	128
La Posta Quartz Diorite	129
Age Relations	131
Stone Quarries in Plutonic Rocks	132
Pegmatite and Silexite Dikes	132
Commercial feldspar and silica	134
MIXED ROCKS	134
Gold Mines in the Mixed Rocks	137
CENOZOIC ROCKS	137
Poway Conglomerate (Eocene)	137
Table Mountain Formation	138
Jacumba Volcanics	138
Age Relations	139
Diabase Dike	140
Gray Gravels (Late Quaternary)	140
MINERAL SPRINGS	141
LIST OF REFERENCES	141

ABSTRACT

This paper deals with a geologic section, about seventy miles long, across the Peninsular Mountains of California from near La Mesa, San Diego County, to near Coyote Wells, Imperial County. A detailed geologic map of 250 square miles accompanies the paper.

Late Jurassic mountain-making involved folding of strata and great intrusions of plutonic rocks throughout the region. By late Tertiary time the whole area was reduced to a topographic condition of late old age. Then the whole region was uplifted to a height of several thousand feet, with a profound fault along the eastern side. The uplift was accompanied by the development of many minor fault

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blocks whose summits generally represent well-preserved old-age erosional surfaces at various levels. Streams have cut many gorges into the great broken-up fault block.

The oldest formation is the meta-sedimentary Julian schist of Triassic or greater age. The Black Mountain volcanics are also probably Triassic. These formations are cut by an extensive series of plutonic rocks ranging in composition from gabbro-diorite to granodiorite and granite. These are the Viejas gabbro-diorite and metadiorite, Alpine quartz diorite, Harbison quartz diorite, Descanso granodiorite, and La Posta quartz diorite. These are all closely related genetically, and all are probably of late Jurassic age. Granite, pegmatite, and silexite dikes are offshoots of certain of the more acidic intrusives.

Various areas of mixed rocks contain intimate associations of schist, diorite, and granite.

The Eocene Poway conglomerate occurs in the west, and the late Tertiary or early Quaternary Table Mountain sands and gravels, and Jacumba volcanics, occur in the east.

Quaternary gray gravels, both nonmarine and marine, and recent valley alluvium complete the list of formations.

The principal economic products are building stones from the igneous rocks; feldspar and silica from the pegmatite and silexite dikes; gold ores in veins in the mixed rocks; and the mineral springs at Jucumba Hot Springs and Buckman Lithia Springs.

INTRODUCTION

Purpose and Scope of the Paper.

As part of a program of study of the crystalline rocks of southern California, the writer has run a geologic section more than seventy miles long across the Peninsular Range from La Mesa, near San Diego, eastward to Coyote Wells in the Imperial Valley. The work has involved the making of a geologic map of about 250 square miles of the region. Many observations were, however, made beyond the limits of the map, and these have helped considerably in the interpretation of the mapped area.

The writer's primary interest has been a study of the kinds, ages, distribution, structure, origin, and relations of the crystalline rocks of the region. Particular attention has been paid to working out the sequence of the Mesozoic plutonic rocks. The paper is intended to be a contribution to the comparatively little known geology of the Peninsular Range of southern California.

Attention is also given to the mines, quarries, and springs of the region.

Previous Work.

The literature contains many references to geological features and mines of the mountains of San Diego County, but most of the statements are brief or very general. Certain reports of the California State Mining Bureau contain descriptions of the mines, with some mention of the associated rocks. Attention will now be called to the more important papers which have some bearing upon the geology or history of the region between San Diego and the Imperial Valley.

W. P. Blake* (1856, pp. 122–130, 176) took some geological notes in 1853 on a trip from San Filipe to San Diego.

J. S. Newberry (1861, pp. 13–18) made some general notes on the geology during a trip from San Diego to Yuma in 1857.

W. A. Goodyear (1888, pp. 516–528) stated that most of the region by far consists of granitic rock containing some narrow belts of schist and marble. He also briefly described the general topography, comparing the mountains with the Sierra Nevada.

W. Lindgren (1888, pp. 173–196), as a result of reconnaissance work, briefly reported on the topographic and geologic features of Baja (Lower) California and made some comparisons with the Peninsular Range of southern California.

H. W. Fairbanks (1893, pp. 76–92) made a valuable reconnaissance geological survey of most of the Peninsular Range of southern California in 1892. In San Diego County he recognized Cretaceous and Tertiary formations on both the west and east sides; older volcanics on the west and younger volcanics on the east; a great area of granite, gneiss, syenite, diorite making up most of the interior region; some smaller bodies of gabbro-diorite; and some belts of a schist-quartzite-marble series. A reconnaissance geologic map accompanies the report.

F. J. H. Merrill (1914, pp. 1–113) published a paper on San Diego and Imperial counties in which the physiography and geology are treated in a very general way, most of the space being devoted to mining features.

A. J. Ellis and C. H. Lee (1919, pp. 1–76) in an elaborate paper on the ground waters of western San Diego County made valuable observations on the physiography and geology, but they made no attempt to study the pre-Cretaceous crystalline rocks of the region.

F. S. Hudson (1922, pp. 175–212) during the years 1917–1919, made a detailed study of the geology of the Cuyamaca region which lies just north of the middle of the present writer's geologic section. A detailed geologic map, on which are differentiated a meta-sedimentary schist, quartz diorite, gabbro-diorite, and granite, accompanies the paper.

M. Hanna (1926, pp. 187–247) published an important paper on the geology of La Jolla quadrangle. Most of the paper is devoted to the Cretaceous and Tertiary strata and the physiography, but there is also a discussion of the pre-Cretaceous crystalline rocks—volcanics, gabbo, and diorite—occurring in the northeastern and southwestern parts of the quadrangle. The southeastern corner of the quadrangle includes the western end of the present writer's section across the mountains.

C. O. Sauer (1929, pp. 199–290) has made an elaborate study of the physiography of part of north-central San Diego County. He advocated the theory that faulting has had little or nothing to do with the origin of the various well-defined plateaus and flat-floored valleys of the region, but that they are simply products of stream erosion. This theory is critically examined by the present writer in another publication in which the fault theory is advocated as the explanation of similar valleys and pleateaus in southern San Diego County.

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* For this and succeeding references see the list of publications, chronologically arranged near the end of this paper.

U. S. Grant IV and H. R. Gale (1931, pp. 45–49) have given an account of the later Cenozoic terraces and history of the San Diego region.

M. Donnelly (1934) published a paper on the mineral deposits of the Julian district. It contains a discussion of the rocks and a geologic map of the region along the general lines of the previous work of Hudson.

GENERAL TOPOGRAPHY AND GEOMORPHOLOGY

Topographically the region extending across southern San Diego County from the ocean to the Imperial Valley may be divided into three parts or belts, each with a general northwesterly trend—a middle plateau-like surface constituting by far the largest part of the area; a steep slope descending from the eastern edge of the plateau to the floor of Imperial Valley; and a coastal belt bounding the plateau or highland region on the west.

Viewed in a very broad way the whole mountainous region may be looked upon as a great, considerably eroded Quaternary fault block with a steep eastern scarp and general slope downward toward the west and southwest. The tilt is more pronounced in the north than in the south. Goodyear (1888, p. 519), whose topographic description is particularly good, pointed out 46 years ago the "strong resemblance in the general form and outline of the range, though on a considerably smaller scale, to the shape assumed by the Sierra Nevada." In addition, the great fault block is broken into numerous minor fault blocks standing at various altitudes.

The plateau or highland region, 30 to 50 miles wide, is for the most part considerably dissected by many streams. Numerous gorges and canyons, from 500 to 1500 feet deep, have been cut into the plateau. Many of the prominent ones follow fault zones of weakness. The plateau surface generally increases in altitude from 1500 to 3500 feet in its western portion, as in Cowles, San Miguel, and Otay mountains, to over 4000 feet in McCains Plateau and over 6000 feet in the Laguna Mountains in the eastern part of the highland. This eastward increase in altitude is, however, by no means gradual because the plateau has been broken by faulting into many large and small blocks, most of which stand out in the form of more or less well-defined secondary plateaus, while some others, relatively less uplifted and usually smaller, mark sites of valleys. Various small and large blocks of the great broken-up plateau surface, representing a former old-age erosional surface, are still but little affected by stream dissection, as for example, south of Alpine (2000 feet); south and southwest of Guatay Mountain (4000 feet); west of Buckman Springs (4200 feet); the top of the Laguna Mountains (5500 to 6000 feet); and the much larger area of about 130 square miles (4000 feet) lying between La Posta and Jacumba valleys. Certain of the blocks rose a good deal less than immediately adjacent ones, and so they appear like relatively sunken fault blocks or graben. Good examples are Viejas, Cottonwood, Morena, and Potrero valleys, the valley just east of Jamul Mountain, and the valley just northwest of Tecate Mountain. The surfaces of some of these fault blocks have been little affected by erosion. Some of them have in fact, from time to time, stood at sufficiently low levels with reference to their surroundings to be basins favorable for accumulation of alluvial materials, or even of lake beds.

The eastern front of the plateau, facing the desert, is generally a high, steep, eroded fault-scarp, representing a southeasterly extension of the Elsinore fault. Thus the descent from Monument Peak or Vallecito View (altitude, over 6000 feet) on the Laguna Mountains to the floor of the valley at the foot of the scarp, is approximately 4500 feet in 4 or 5 miles. Farther south there is a descent of about 3000 feet in 5 or 6 miles from the top of the Jacumba Mountains (altitude, over 4000 feet) to the floor of the desert.

The coastal belt, bounding the plateau on the west, is some 8 to 12 miles wide east of San Diego and Mission bays. It consists very largely of a series of well-defined Quaternary marine terraces rising to successively higher levels up to 1200 feet or more at and near the western base of the great plateau. This terraced coastal belt has been considerably dissected by erosion, but wide areas of the lower terraces are still remarkably flat. Both Ellis (1919, pp. 25–30) and Hanna (1926, pp. 192–198) have discussed the terraces at some length.

It is possible that a north-northwesterly fault or fault zone also bounds the major fault block on the west, that is, along the general contact of the highland area of crystalline rocks and the coastal sediments. Ellis (1919, p. 75) presumes that a great fault line existed there during late Cretaceous and Tertiary times, and that the Cretaceous and Tertiary beds were laid down on the subsiding area mostly west of the fault. It is possible that there was considerable renewed movement of such a fault during Quaternary times.

A much fuller account of the geomorphology is given in a paper soon to be published by the writer under the title "Geomorphology of the Southern Peninsular Range of California."

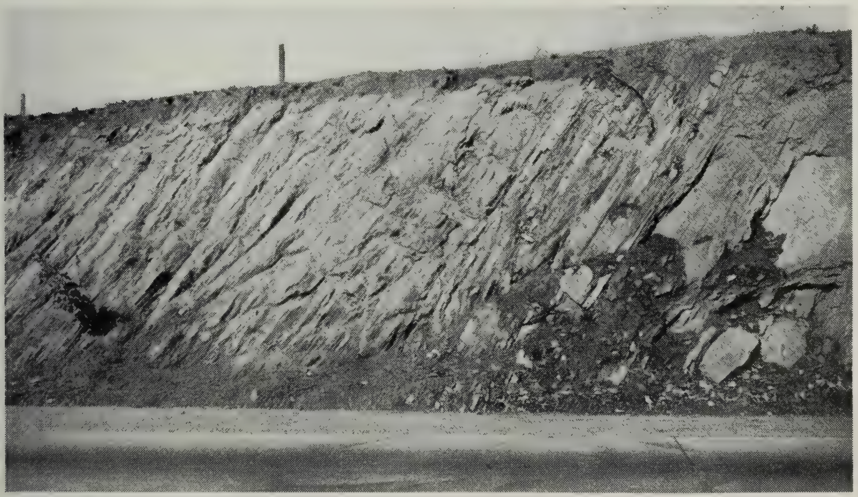

FIG. 1. Julian schist with some quartzitic beds. One and one-half miles east of Lakeview.

EARLIER MESOZOIC (?) ROCKS

Julian Schist (Triassic ?).

Forty-six years ago Goodyear (1888, p. 517) recognized belts of metamorphic rocks including schists and marble in San Diego County. Some years later Fairbanks (1893, p. 82 and p. 87) briefly described and mapped certain belts consisting of mica schist, slate, and quartzite. In his paper on San Diego County, Merrill (1914, p. 12) applied the name "Julian Group" to the metamorphic rocks consisting of "mica schist, slates, quartzites, and limestones, the first being especially well exposed near Julian, and the latter occurring in small areas at several points." Hudson (1922, pp. 182–190) called these metamorphic rocks in the Cuyamaca region the "Julian Schist Series" and described them in considerable detail.

Meta-sedimentary rocks assigned to the Julian schist series occur in the region under consideration in the present paper, but, as usual in San Diego County, they are much less extensively developed than the plutonic rocks. Also, most of the meta-sediments by far are so closely involved with certain of the plutonics that they are included in the areas mapped as mixed rocks. Some comparatively small areas are, however, sufficiently free from admixed plutonic material to be separately mapped. Enough examples will be described to give the reader a good idea of the character of the Julian schist series.

The four areas east and northeast of Lakeside, and the small one just south of Descanso, contain almost wholly gray, rather fine to medium-grained, crudely foliated mica schists, most of them quartz-biotite schists with some thin beds of quartzite. The mapped area 2 to 2½ miles northeast of Mountain Springs contains mostly gray mica schist with some interbedded quartzite and some crystalline limestone. In all of these areas of metasediments foliation and bedding seem to be essentially parallel, and the dips are very steep. Also some granitic material locally cuts the schists, usually in lit-par-lit fashion.

A few of many examples of metasediments closely involved with granitic rocks in areas of mixed rocks are here described. Thus, along the road one mile northwest of Pine Valley P. O., bands and irregular masses of mica schist occur in well-foliated granite. A thin section of the fine-grained schist shows by volume percentages: plagioclase (mainly oligoclase), 47; quartz, 28; biotite, 15; hornblende, 8; and titanite, 2. Gray, fine-grained, well-foliated impure quartzite is intricately cut by much aplitic granite three-fourths of a mile northwest of Descanso. A thin section contains by volume percentages: quartz, 58; andesine, 20; monoclinic nearly colorless pyroxene, 15; hornblende, 5; magnetite, 1.5; and small amounts of titanite and zircon. Considerable light-gray, fine-grained, foliated, saccharoidal quartzite occurs in the mixed rock area about 2½ miles northwest of Jacumba. In thin section it shows by volume percentages: quartz, 91; sillimanite (in numerous tiny needles), 8; and magnetite, 1.

Age Relations

No fossils were found in the Julian schist series by the writer, and no definite conclusion as to the age of the series was reached beyond the fact that it is certainly pre-Cretaceous. An excellent discussion of the problem of the age of the Julian schist has been published by Hudson (1922, pp. 188–190) and it seems unnecessary to repeat it here. The evidence points to a probable Triassic, or a possible late Paleozoic, age of much or all of the Julian schist series in southern San Diego County. It is, however, entirely possible that the series includes rocks of both Triassic and late Paleozoic (or even older) ages.

In this connection mention will be made of recent observations by the writer between Elsinore and Perris in Riverside County. Along the main highway for one and one-half miles north of Elsinore there are some good outcrops of Triassic slate and of slate associated with Triassic volcanics. Then for four miles the highway crosses quartz diorite cut by dikes of granodiorite. Nearly a mile north-northeast of Goodhope Mine there is a large outcrop of steep-dipping, moderately crystallized, meta-sedimentary schist which looks almost exactly like the Julian schist near Lakeview and Descanso in San Diego County. Thence to Perris the road passes over more quartz diorite which looks like the Alpine quartz diorite of San Diego County described beyond. The schist near Goodhope Mine is quite certainly a roof pendant or inclusion of the Triassic slate which became more metamorphosed by the action of the intrusive. This evidence suggests strongly that the Julian schist of San Diego County is largely or wholly metamorphosed Triassic sediment.

Black Mountain Volcanics (Triassic or Jurassic ?).

A thick series of volcanic rocks, locally associated with some sediments, occupies considerable areas along the western border of the crystalline rocks of San Diego County from near Oceanside south-southeastward to the Mexican border. These areas are represented in a general way on the geological map accompanying the paper by Ellis and Lee (1919). Hanna called them Black Mountain volcanics from their typical occurrence on Black Mountain in the La Jolla quadrangle where ''they are chiefly volcanic, including agglomerates, although in certain places sediments are present'' (Hanna, 1926, p. 199). He also states that ''the whole series has been metamorphosed, especially in the proximity of the quartz diorite.''

The only occurrence of Black Mountain volcanics in the region mapped by the writer is an area of several square miles at the western end south of La Mesa and Mt. Helix. There are many good exposures but no associated sediments were noted. The rocks seem to be mostly andesites and dacites. A thin section of nearly black, fine-grained, andesite from the hill just south of La Mesa contains by volume percentages: plagioclase (andesine to labradorite), 60; ferromagnesian minerals (mostly chloritized biotite), 38; and magnetite, 2. A dark-gray, fine-grained, slightly porphyritic, augite andesite from the southwestern base of Mt. Helix shows in thin section: andesine, 63; hornblende, 20; augite, 15; and magnetite, 2. Gray, fine-grained dacite occurring five-sixths of a mile southwest of the top of Mt. Helix contains: andesine, 32; quartz, 45; hornblende, 16; pyrite, 4; zircon, 2; and magnetite, 1. Similar rock occurs on the hill in the eastern part of La Mesa.

In the vicinity of La Mesa the Black Mountain volcanics are generally so massive in the outcrops that it is usually difficult, if not impossible, to determine dip and strike, but for the most part they seem to dip southwestward at a low angle.

Age Relations

East of La Mesa it is plainly evident that the Alpine quartz diorite (described beyond) cuts the Black Mountain volcanics in the form of dikes large and small, and also there are inclusions of the volcanics in the diorite. The relation of the Julian schist to the volcanics was nowhere observed.

If, as pointed out beyond, the Alpine quartz diorite is of late Jurassic age, then the Black Mountain volcanics are Jurassic or older. Hanna (1926, pp. 203–204) discusses the age of these rocks in La Jolla quadrangle and concludes that "although definite paleontological data are not at hand it is probable that the Black Mountain volcanics are of Upper Triassic or Jurassic age."

Economic Value

Crushed rock has many well known uses. For such purposes the lavas of the Black Mountain formation are better than the average. This is because the lavas are fine-grained, both hard and tough, and rich in iron-bearing minerals which latter, when a little altered by weathering, yield natural binding material in the form of iron oxides. There is almost no limit to the amount of easily available rock of this kind in the large area of Black Mountain volcanics south and east of La Mesa. The H. G. Fenton Materials Company operates a large quarry and stone crusher on the hillside about one mile south of La Mesa, known as the Spring Valley Plant.

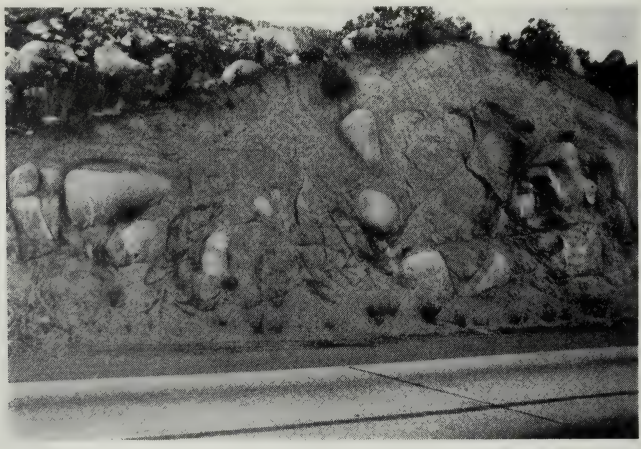

FIG. 2. Residual boulders in Viejas gabbro-diorite, with boulder-strewn surface at the upper left. Along the road two and one-half miles west-southwest of Descanso.

LATE MESOZOIC (?) PLUTONIC ROCKS

Viejas Gabbro-diorite.

This formation is called the Viejas gabbro-diorite by the writer because of its typical occurrence in Viejas Mountain. It varies considerably in composition, color, texture, and structure. Varieties include olivine gabbro-diorite, norite, and quartz gabbro-diorite, but most of the rock by far is quartz gabbro-diorite rich in plagioclase and containing augite, biotite, and hornblende. Color variations range from light gray to almost black. The texture is usually medium-grained, but with variations to coarse and fine-grained. Much of the rock is very massive, but locally, and more especially close to contacts, it is often distinctly foliated or even schistose. There are also local developments of more or less well-defined magmatic flow-structure banding. The massive varieties show little or no granulation in thin sections. Distinctly red soils are derived from the gabbro-diorite, as is well shown on Viejas Mountain.

The Viejas Mountain, Alpine Heights, and Las Bancas areas are much the largest, each containing several square miles. An area of about two-thirds of a square mile lies just north of Buckman Springs, and two much smaller bodies somewhat doubtfully classed as Viejas quartz gabbro-diorite occur in the general vicinity of Mountain Springs.

Excellent exposures occur in the Las Bancas area in fresh road cuts along the new Viejas grade between one and one-half and two miles southwest of Descanso. Several thin sections of this rock contain by volume percentages: andesine, 55 to 75; quartz, 12 to 20; augite, 3 to 14; biotite, 7 to 12; hornblende, 0 to 4; magnetite, $\frac{1}{4}$ to 1; and sometimes very small amounts of apatite, zircon, or pyrite. There is little or no granulation. These outcrops are medium gray, medium grained, and massive, but a little further west (down the grade) the same formation locally contains fine-grained and schistose facies where dikes of granodiorite or granite cut it. Similar rock occurs throughout other portions of the Las Bancas area.

The Viejas Mountain area shows many variations of the gabbro-diorite formation. Exposures on the western face of the mountain contain medium-grained rocks with crude primary banding, the light-gray and dark bands being an inch or less wide, and other rocks which are medium to dark-gray and more uniform in structure. Thin sections of the banded rock show that the light bands are very largely labradorite and the dark bands mostly hypersthene together with some hornblende and magnetite. This rock is, therefore, essentially a norite. A thin section of the gray, uniform rock from one and one-half miles northeast of Alpine shows by volume percentages: andesine, 66; quartz, 11; biotite, 8; hornblende, 7; augite, 7; magnetite, 1; and a little zircon.

The Alpine Heights area consists mostly of rather uniform, dark-gray, medium-grained, massive, quartz gabbro-diorite, the composition of which is similar to the Viejas Mountain rock.

In the Buckman Springs area most of the rock is dark-gray, medium-grained, massive, olivine gabbro-diorite, a thin section of which shows by volume percentages: plagioclase (andesine to labradorite), 63; biotite, 20; olivine, 6; augite, 5; hornblende, 5; and pyrite, 1. Local variations, particularly near the borders of the area, range from crudely foliated, finer grained, and more biotitic to dark-gray biotite schist. such metamorphism having been caused by the later granite intrusions. One outcrop in the midst of the area is massive and very coarse-grained. It has a crude ophitic texture with hornblendes as much as two inches long, but biotite is absent.

The several small areas in the vicinity of Mountain Spring are probably to be classed with the Viejas gabbro-diorite. These rocks are notably variable, ranging from medium-grained, dark-gray, massive gabbro-diorite to distinctly foliated and schistose facies rich in biotite. They have been cut and more or less intimately injected with acidic material from the surrounding quartz diorite. The metamorphic facies were no doubt produced by the action of the later intrusive. Other very small areas along and near the Mountain Spring grade are not shown on the map.

Age Relations

The Viejas gabbro-diorite is quite certainly younger than the Julian schist. Thus in the northern part of the Buckman Springs area a number of lenslike inclusions of Julian schist occur in the gabbro-diorite. Gabbro-diorite masses within the areas of mixed rocks also sometimes contain inclusions of the schist and send dikes into it, as for example, along the road about a mile northwest of Pine Valley.

The Viejas gabbro-diorite and the Alpine quartz diorite are believed to be closely related genetically. It is difficult, if not impossible, to draw sharp boundary lines between the two lots of rocks. The Alpine diorite is quite generally more acidic than the Viejas gabbro-diorite, but gradational facies seem to be common, as in the general vicinity of Alpine. Although the two rocks undoubtedly represent differentiation phases of a single magma, nevertheless certain evidence indicates that at least some portions of the Viejas gabbro-diorite magma rose and consolidated before the Alpine quartz diorite magma was emplaced. Part of the evidence is the occurrence of numerous small inclusions of dark metagabbro-diorite (presumably Viejas gabbro-diorite) in the Alpine quartz diorite in some places where the Alpine diorite borders the Viejas gabbro-diorite. Such inclusions may be seen along and near the road on the south side of Viejas Valley. Swarms of them occur in quartz diorite in road cuts one mile southwest of Alpine Heights. Along the State Highway about two and one-half miles west-southwest of Descanso an exposure of Viejas gabbro-diorite 100 yards long and 50 to 75 feet high varies from a medium-grained, massive facies to a finer grained, foliated (amphibolitic) facies. It is cut irregularly by dikes of Alpine quartz diorite, these dikes varying from less than an inch to 25 feet in width. Some strips of the amphibolite in the quartz diorite are cut by small dikes of the latter. The diorite of this vicinity is somewhat variable in color (lighter to darker) and in composition, probably because of some absorption of gabbro-diorite material by the quartz diorite. It is, therefore, plain that this Alpine quartz diorite is at least somewhat younger than the Viejas gabbro-diorite of this vicinity.

A large fresh exposure along the State Highway one-half mile southeast of Lakeview contains Viejas gabbro-diorite cut by a network of dikes of Alpine quartz diorite. The contacts are more or less fady, thus indicating strongly that the gabbro-diorite was still hot when the quartz diorite magma entered it.

The larger areas of undoubted Viejas gabbro-diorite are nowhere in contact with the extensively developed La Posta quartz diorite. If, however, the several small bodies near Mountain Spring are to be classed as Viejas gabbro-diorite, then this rock is certainly older than the La Posta diorite, which plainly surrounds and sends dikes into the two bodies.

The Cuyamaca basic intrusive, as described by Hudson (1922, pp. 193–207), is in many respects like the Viejas gabbro-diorite, especially that of the Viejas Mountain and Buckman Springs areas, and his Stonewall quartz diorite (Hudson, 1922, pp. 190–192), probably corresponds to the present writer's Alpine quartz diorite, or possibly to the La Posta quartz diorite. Hudson definitely finds his basic intrusive to be younger than his Stonewall quartz diorite, and, in spite of the writer's finding considerable evidence to the contrary, as already mentioned, it is possible that at least some of the rock classed as Viejas gabbro-diorite may be younger than the La Posta quartz diorite, conclusive field evidence not having been found. The Viejas gabbro-diorite is, however, quite certainly not younger than the Alpine quartz diorite.

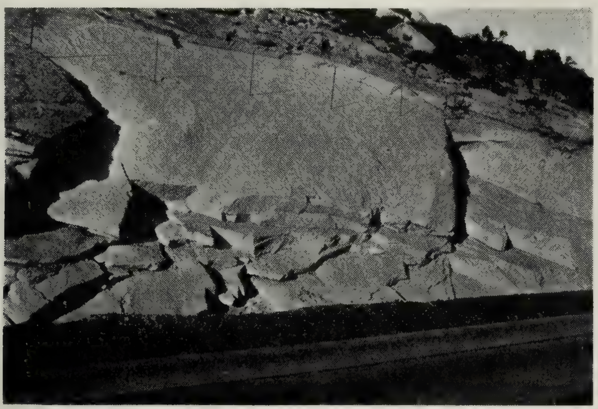

FIG. 3. An outcrop of La Posta quartz diorite showing sheet-jointing. Along the road four miles northwest of White Star.

The Harbison quartz diorite and the Descanso granodiorite are both distinctly younger than the Viejas gabbro-diorite, as proved for example by dikes of the acidic rocks cutting the gabbro-diorite along the main road one and one-half miles southwest of Descanso; east of Harbison Canyon; and along the main road one-half a mile southeast of Lakeview.

If, as already pointed out, the Viejas gabbro-diorite and the Alpine quartz diorite are of essentially the same age, and, if as pointed out by Hanna (1926, pp. 203–204), the Black Mountain volcanics are probably of late Triassic or Jurassic age, then the Viejas gabbro-diorite is of post-Triassic and pre-Cretaceous age. The gabbro-diorite is also younger than the Julian schist of Triassic (?) age. It must be admitted, however, that the geologic ages of the Viejas gabbro-diorite and Alpine quartz diorite are not positively known.

Alpine Quartz Diorite.

The Alpine quartz diorite is so called by the writer because of its typical occurrence in the general vicinity of Alpine. It is usually more uniform in composition, color, texture, and structure than the Viejas gabbro-diorite. It is very commonly a medium to light-gray, medium-grained, massive to slightly foliated quartz diorite, containing 55 to 70% plagioclase (oligoclase to andesine), 8 to 20% quartz, 5 to 25% hornblende or biotite or both, and some tiny grains of zircon, apatite, and megnetite. Thin sections show little or no granulation. Scattering basic lens-like segregation masses or *schlieren* a few inches long often occur and these usually lie parallel to the slightly developed magmatic flow-structure foliation. The Alpine quartz diorite yields brown residual soil.

Three areas of Alpine quartz diorite are shown on the accompanying geologic map. One of the two largest areas is in the El Cajon vicinity and the other extends eastward and northwestward from Alpine. Each of these areas, including the floor of El Cajon Valley, which is largely or wholly underlain by this rock, contains more than twenty square miles. A third area of about six square miles is crossed by Harbison Canyon.

The rock in the El Cajon area is mostly typical Alpine quartz diorite as shown by a study of outcrops, hand specimens, and thin sections. Just south of Santee the rock shows about 7 per cent each of monoclinic pyroxene and hornblende, and much of the hornblende seems to have been derived from pyroxene, there often being irregular residual cores of pyroxenes in the hornblendes.

Dikes of the Alpine quartz diorite cutting the Black Mountain volcanics west and south of Mt. Helix seem to be more acidic than usual. One of the thin sections shows: plagioclase (mostly andesine), 60; quartz, 36; biotite, 3; and less than one per cent each of hornblende, zircon, magnetite, and apatite. Another section contains much granophyre.

Age Relations

In view of the fact that the Alpine quartz diorite and Viejas gabbro-diorite are, as already pointed out, probably very closely related genetically, the age relations of the Viejas gabbro-diorite to both older and younger formations already discussed apply also to the Alpine quartz diorite.

Harbison Quartz Diorite.

This rock is so named here because of its typical occurrence in the northern part of Harbison Canyon and vicinity. This area of about six square miles is, with one small exception to the south, the only one occurring in the region under study.

The Harbison quartz diorite is distinctly more acidic than any of the diorites already described. In the field it was first mistaken for aplitic granite, but it contains no potash feldspar. It is generally light to very light-gray, and fine-grained varying locally to medium-grained. It varies from massive to distinctly foliated, the foliation being a primary structure particularly in the border portions near the (older) Alpine quartz diorite. Thin sections show little or no granulation. It weathers to a brownish-yellow soil.

A thin section of the typical, light-gray, medium-grained, distinctly foliated rock from near the highway two miles east of Los Coches Tunnel contains by volume percentages: oligoclase, 55; quartz, 40; magnetite, 2.5; biotite, 1.5; hornblende, 1; and a little zircon. Another specimen from this vicinity is similar, except that it is poorer in oligoclase and richer in quartz.

In and near Harbison Canyon the rock is similar in composition to that just described, but it is very massive. It is medium to fine-grained and remarkably free from dikes or inclusions.

Rocks very similar in appearance and composition to the Harbison quartz diorite were observed in dikes cutting the mixed rocks one and two-thirds miles north of Buckman Springs and one mile northwest of Pine Valley P. O.

Age Relations

The Harbison quartz diorite is certainly younger than the Alpine quartz diorite as proved by the dikes (often pegmatitic) of the former in the latter. Such dikes may be seen along the road three miles west-northwest of Alpine and in lower Harbison Canyon. The age relations of the Harbison and La Posta quartz diorite and Descanso granodiorite are considered beyond, all of these probably being of later Jurassic or earlier Cretaceous age.

Descanso Granodiorite.

This formation is so named by the writer because of its typical occurrence in the general vicinity of Descanso. Five areas covering a total of about twenty-eight square miles are mapped as such in the region under consideration. Three of these areas lie south to northwest, south-southwest, and northeast to east of Descanso; another lies southeast of Pine Valley; and a fifth in the general vicinity of Lakeview. In addition, much of the granodiorite varying to granite that occurs in the rather extensive areas of mixed rock complexes is believed to belong in this category. Good examples occur in the immediate vicinity of Descanso. Inclusions of metadiorite or paraschist, or both, too small to be separately represented, often occur in various parts of the mapped areas of Descanso granodiorite. This is particularly true of the Lakeview area. Where these older rocks assume considerable quantitative importance in close association with the granodiorite, such an area is mapped as a mixed rock complex.

The Descanso granodiorite is almost everywhere light-gray, medium-grained with local finer-grained variations, and often more or less distinctly gneissoid, especially near the borders of the areas. In all of the thin sections examined the potash feldspar is microcline (12 to 50 per cent) and the plagioclase is all, or nearly all, oligoclase (18 to 38 per cent). Hornblende or biotite or both are always present in amounts ranging from 1 to 10 or 12 per cent. A typical specimen taken from a road cut two miles west-southwest of Descanso is light gray, medium-grained, and distinctly gneissoid. In thin section it shows by volume percentages: oligoclase, 35; microcline, 27; quartz, 25; biotite, 8; hornblende, 3; epidote, 1.5; and small amounts of zircon, magnetite and apatite. There is considerable granulation of the minerals.

It is evident that the Descanso granodiorite is distinctly more acidic than any of the other plutonic rocks thus far described.

Age Relations

The Descanso granodiorite is younger than the Julian schist. The Julian schist in the two areas east of Lakeview is cut by dikes of the granodiorite. The schist of the mixed rock areas is often cut by granodiorite dikes, as for example by the road one and a half miles northwest of Pine Valley. Inclusions of mica schist also occur in the granodiorite of the mixed rock areas.

The Viejas gabbro-diorite is older than the Descanso granodiorite, as proved by various dikes of the latter cutting the former along and near the new Viejas grade one and one-half to two miles southwest of Descanso.

The Alpine diorite covering four or five square miles, east and southeast of Santee is cut by a good many dikes of the Descanso granodiorite, thus proving the granodiorite to be distinctly younger.

The Descanso granodiorite is nowhere in contact with the Harbison quartz diorite. It has already been pointed out that the age relations of these two formations are not positively known, but it is rather confidently believed that they are of the same, or nearly the same age, that is late Jurassic or early Cretaceous. The age relations of the Descanso granodiorite and La Posta quartz diorite are discussed beyond.

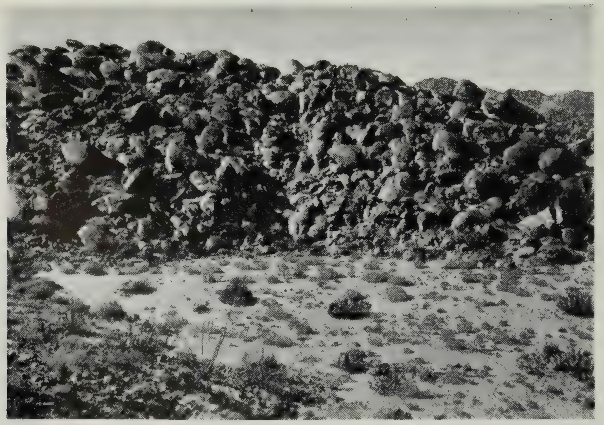

FIG. 4. La Posta quartz diorite boulders of weathering. Near the road four and one-half miles northeast of Mountain Spring.

La Posta Quartz Diorite.

The La Posta quartz diorite is so named by the writer because of its typical occurrence in large exposures in the general vicinity of La Posta Valley. In the region under study this rock occurs only from Cottonwood Valley eastward to the foot of the mountains, but it there constitutes by far the greatest bulk of exposed rock. Very commonly it is distinctly lighter gray than the Alpine quartz diorite.

From Cottonwood Valley southeast to the vicinity of Boulevard, a distance of sixteen miles, La Posta quartz diorite is remarkably uniform in composition, structure, and texture, and it contains very few inclusions of dikes. In the field it may easily be mistaken for granodiorite or even granite. It extends for miles both north and south of the road. Much of this rock is badly decomposed to a depth of 10 or 20 feet, but there are many good exposures especially in road cuts along the new state highway. Fine outcrops, typical of much of this rock, occur along the road just west of La Posta Valley. This rock is light-gray, medium-grained, nonfoliated. Thin sections show by volume percentages: oligoclase to andesine, 70; quartz, 20; biotite, 6; hornblende, 3.5; and small scattering grains of titanite and magnetite. There is little or no granulation. The biotite is mostly in the form of books with hexagonal outlines ranging to one-fifth of an inch across. Hornblendes as much as one-third of an inch long often have good crystal boundaries. The titanite grains are often visible to the naked eye.

The quartz diorite along the road about four miles northwest of White Star is very similar, but it contains some grains of apatite and zircon.

From Jacumba Valley northeastward to the foot of the mountains much of the La Posta quartz diorite is very similar to the typical rock already described, but it varies more and it is usually richer in dark minerals. Locally, the color varies from very light-gray to medium-gray; the texture from medium to rather fine-grained; and the structure from non-foliated to distinctly foliated. Such variations are generally more pronounced comparatively near the large and small inclusions of older rocks, some of the latter being shown on the map. Contamination of the quartz-diorite magma by assimilation of some dark material from older metadiorite probably accounts for the usually higher ferromagnesian content, while marginal chilling and frictional drag of the magma alongside the inclusions probably account for the variations in texture and foliation.

Some of the inclusions of the dark-gray metadiorite varying to gabbro-diorite (Viejas ?) in the La Posta quartz diorite between Jacumba and the desert may from a little distance be easily mistaken for dikes. They are often remarkably long, straight, and narrow. An excellent case in point is the pseudodike, 10 to 15 feet wide, extending hundreds of feet on the face of the upper part of a small mountain three miles east of Jacumba. Still finer examples were observed near the base of the mountains a little north of the boundary of the accompanying geologic map. One of these is at least 1000 feet long, very straight, and not over 25 feet wide.

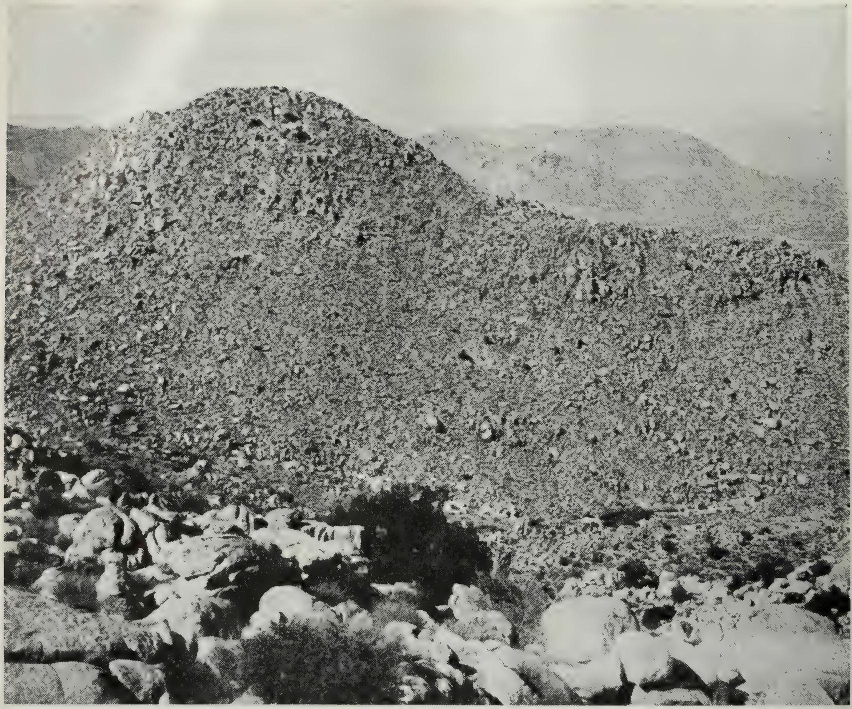

FIG. 5. A mountain of highly fractured La Posta quartz diorite strewn with boulders of weathering in a fault zone, near Mountain Spring.

A thin section of the medium-gray, medium-grained, nonfoliated diorite from Boulder Park shows: oligoclase, 64; quartz, 28; biotite, 7.5; and small scattering grains of zircon and apatite. It is more acidic than the average Alpine quartz diorite. A specimen from a mile east of Mountain Spring contains: oligoclase to andesine (mostly the latter), 60; quartz, 15; hornblende, 20; biotite, 4; magnetite, 1; and a very little apatite. It is distinctly more basic than the usual La Posta quartz diorite and this may be a result of assimilation of some of the older basic rock which occurs in this vicinity. The rock is also distinctly foliated, this structure probably being a magmatic flow structure produced by frictional drag alongside several large and small masses of included country rock in this vicinity. This is strikingly illustrated near the borders of the body of mapped Julian schist.

Farther down the road, toward the base of the mountains, the rather variable rock is light to medium-gray, medium-grained, usually faintly foliated, and contains some small scattering *schlieren* parallel to the foliation. A thin section of the most common facies shows: oligoclase with little andesine, 75; quartz, 17; biotite, 5; hornblende, 1; titanite, 1; and scattering grains of apatite, eqidote, and magnetite. The yellow titanite crystals are easily visible to the naked eye. One darker-gray basic facies by the road at the foot of the mountain contains considerably more andesine and biotite, and less quartz, than the specimen last described. Another facies contains 5 or 6 per cent of hypersthene.

Age Relations

The La Posta quartz diorite is quite certainly younger than the Julian schist. Not only is this strongly indicated by the generally massive, nonfoliated, and nongranulated character of the diorite, but also because it plainly sends dikes into the body of mapped metasediments (presumably Julian schist) east of Mountain Spring.

The several mapped bodies (and others) of basic rock (diorite to metadiorite) in the vicinity of Mountain Spring very probably belong to the Viejas gabbro-diorite formation, and if so, the latter is older than the surrounding La Posta quartz diorite because dikes of the latter occur in the gabbro-diorite, and its metadiorite variants. The Alpine and La Posta quartz diorites were nowhere seen together, and it is possible that the two are not very different in age. The La Posta quartz diorite is, however, probably younger than the Alpine quartz diorite because the latter is so closely related to the Viejas gabbro-diorite which in turn is very likely older than the La Posta diorite as above indicated. This means, in other words, that the La Posta quartz diorite is probably of younger late Jurassic age than the Alpine diorite, or it may even be early Cretaceous age.

The age relations of the Harbison quartz diorite and Descanso granodiorite to the La Posta quartz diorite were not positively determined, but the La Posta quartz diorite is probably the youngest, as is strongly suggested by its intrusive relation to the older mixed rocks (including Descanso ? granodiorite) north of Cameron Valley and northwest of Jacumba, discussed beyond. The La Posta quartz diorite, therefore, seems to be the youngest of all the largest intrusive bodies of the region under consideration in this paper, and if so, it is quite certainly of late Jurassic or Cretaceous age.

In Lower California certain granitic intrusives between San Tomas and San Vicente are said, by Böse and Wittich (1913, pp. 347–351), to cut middle Cretaceous strata and to be overlain by Upper Cretaceous strata. A. O. Woodford, in a personal communication, says: ''Some years ago I visited what I think to have been their locality and found the intrusive granitic rock (invading volcanics supposed to be middle Cretaceous) finer grained than the usual diorite of the region and also of peculiar appearance. I do not yet feel sure of the conclusion that all the granitic rocks of the region are Cretaceous.'' May these volcanics be older than middle Cretaceous and possibly correlate with the Black Mountain volcanics of western San Diego County?

Darton (1921, p. 726) in his paper on Lower California says that ''pre-Chico Cretaceous rocks are cut by dikes and large stocks of igneous rocks of various kinds.'' Are these igneous rocks diorite and grano-diorite or are they dike and volcanic rocks of Tertiary age?

Fairbanks (1893, p. 119) says: ''I believe that the great convulsion which upheaved and metamorphosed the older rocks (of San Diego and Orange counties), and intruded granite into them, took place, as it did in central and northern California, between the Cretaceous and the Jurassic. There is no break in the line of granites and crystalline schist the whole length of California.''

Hinds (1934, p. 192), after summarizing existing knowledge in regard to the last great intrusives of the Sierra Nevada and Klamath Mountains, concludes that these intrusives are of late Jurassic age.

It is possible, then, that some of the later intrusives of San Diego County are of earlier Cretaceous age, but the best evidence points to the late Jurassic age of most, if not all, of the great intrusives of the region.

Stone Quarries in the Plutonic Rocks.

There is a practically unlimited supply of rock for various commercial uses in the plutonic series of the region.

A number of quarries were operated in several types of the plutonic rocks for the purpose of obtaining large quantities of excellent crushed rock used in the building of the state highway all the way across the mountains.

A number of quarries yielding excellent building stone and stone for monuments are located in the vicinities of Santee and Lakeside. In the Simpson-Pirnie quarry at Santee the rock is Alpine quartz diorite. It is locally called ''Santee granite.'' It is uniform, light-gray, medium-grained, very massive, and free from bad seams. It can be removed in large blocks. A smaller quarry in similar rock is situated a little south of Santee. Excellent building stone could be quarried in many parts of the extensive Alpine quartz diorite areas between La Mesa and Viejas Valley.

The Descanso granodiorite is a possible source of good building stone in many places. The only important quarrying operations are in the vicinity of Lakeside just north of the western part of the area shown on the geologic map. The Eucalyptus and the McKoon quarries are the principal ones. In each quarry the rock, known as ''Silver-gray granite,'' is a phase of the Descanso granodiorite. It is light-gray, fine-grained, and uniform in color and texture. It is easily obtained in large blocks.

Excellent building stone could be quarried in many parts of the extensive areas of La Posta quartz diorite between Cottonwood Valley and Jacumba. Much of this rock is covered by residual soil and rotten rock, but the fine quality of the fresh rock is shown in several road cuts and roadside quarries.

Pegmatite and Silexite Dikes.

Pegmatite dikes are usually small and by no means common in the Viejas and Alpine diorites. In view of the fact that these dikes are offshoots of the later and more acidic (Harbison, Descanso, and La Posta) intrusives, they are much more likely to occur in the border portions of the diorites comparatively near contacts with the acidic source rocks. An excellent case in point is a group of pegmatite dikes, representing offshoots of the Descanso granodiorite, cutting the Viejas gabbro-diorite in high fresh exposures along the state highway about two and one-half miles west-southwest of Descanso. These pegmatites are quite generally very simple in composition (quartz, potash feldspar, and some mica) and not very coarse-grained.

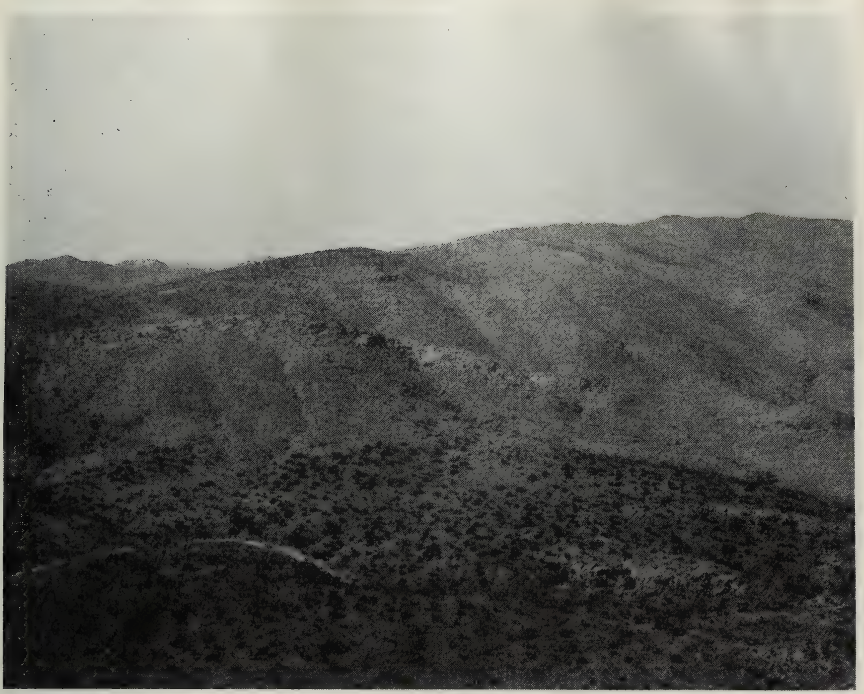

FIG. 6. A group of roughly parallel pegmatite dikes cutting the schist-metadiorite-granite complex about two miles north-northwest of Jacumba.

Within the large bodies of the more acidic intrusive (Harbison, Descanso, and La Posta) pegmatites are in most places surprisingly scarce and small, seldom being more than a few feet wide. Thus the remarkably uniform La Posta quartz diorite, extending many miles from Cottonwood Valley to east of Boulevard contains very few pegmatites.

In the areas mapped as mixed rocks, however, pegmatite dikes are rather common. Thus the mixed rocks of the schist-metadiorite-granite complex west and northwest of Jacumba are cut throughout by numerous moderately coarse-grained, muscovitic granite-pegmatites, many of them cross-cutting the general northwesterly structure of the complex, often forming networks, and many others showing a strong tendency to follow the structural trend.

Dikes of pegmatite and pegmatitic granite also occur in various parts of other areas of mixed rocks, particularly in the large Buckman Springs-Pine Valley-Descanso area.

Special mention may be made of an interesting group of pegmatite dikes west of Jacumba, there being some good exposures in and near a road just west of the town. The main rock here is a gray, moderately coarse-grained quartz diorite (probably impure La Posta diorite) containing a well-defined, irregular, steep-dipping inclusion of mica schist (Julian ?). This combination is cut sharply by banded pegmatite dikes, each dike consisting of both granite and moderately coarse-grained pegmatite arranged in distinct, though not sharply separated, alternating layers parallel to the walls of the dikes. The dikes are several feet wide. The cause of the layered structure is, indeed, puzzling.

The most interesting silexite dikes form a group of four or five at and near the road summit one to one and one-half miles southeast of Pine Valley P. O. Their bold outcrops are strikingly visible from the state highway. These dikes are usually not more than 25 to 30 feet wide and 100 to 200 feet long. They consist very largely of pure white, massive quartz, but locally there are a few scattering potash feldspars thus strongly suggesting that these silexite dikes are facies of pegmatite dikes.

As already stated, many pegmatite dikes cut the mixed rocks west and northwest of Jacumba, and some of these are so quartz-rich as to belong in the category of silexite dikes. Elsewhere in the region under study silexite dikes occur very sparingly.

Commercial Feldspar and Silica

Most commercial feldspar comes from pegmatite dikes, and much silica comes from pegmatite and silexite dikes, the silexite being practically pure silica. There has been some mining of these minerals within the area discussed in this paper. Both feldspar and silica have been shipped from the Lakeside Feldspar Mine three and one-half miles east-southeast of Lakeview, and from the Marden Feldspar Mine five miles northwest of Jacumba.

A deposit of silica associated with feldspar, two miles south of Boulevard, is owned by a Los Angeles company.

The large, bold, outcropping bodies of nearly pure white silica (silexite) already mentioned as occurring at and near the road summit southeast of Pine Valley have not yet been developed.

One of the largest feldspar mines in California is located about five miles north of Campo, and only a few miles south of the middle of the area discussed in this paper.

With sufficient demand, other pegmatite dikes, rich in feldspar and silica, and reasonably near railroad transportation, may be worked to advantage in southern San Diego County.

MIXED ROCKS

A number of areas of mixed rocks are shown on the accompanying geologic map. Rocks representing various formations occur within these areas but they are so intricately mixed that it would be a practically hopeless undertaking to map them separately. The main constituents are mica schist (presumably Julian) and diorite and metadiorite (presumably Viejas or Alpine, or both) cut by large amounts of acidic facies of Descanso granodiorite or La Posta quartz diorite. Rather arbitrarily these mixed rocks have been mapped in two groups, one called a schist-granite complex and the other a schist-metadiorite-granite complex.

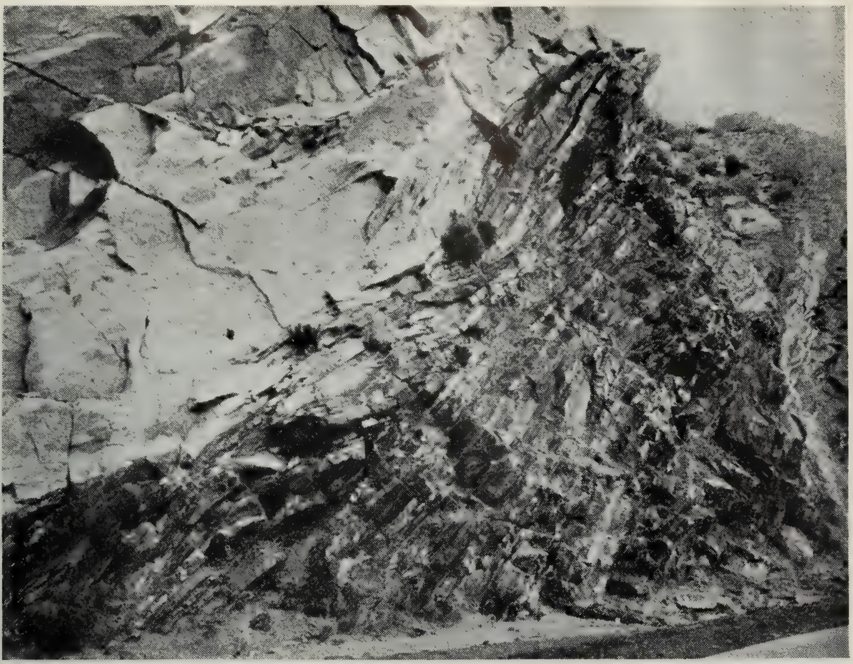

FIG. 7. La Posta quartz diorite cutting Julian (?) schist and sending some dikes into the schist roughly parallel to its foliation. Along the road two miles northeast of Mountain Spring.

The largest area of mixed rocks extends from Cottonwood Valley northwestward through Pine Valley and Descanso. It is mapped as a schist-metadiorite-granite complex. All, or nearly all, of the schist is believed to be part of the Julian schist; the diorite varying to metadiorite most likely belongs with the Viejas gabbro-diorite; and the granitic rocks are largely or wholly part of the Descanso granodiorite. The diorite may be seen to cut the schist at various localities, while the granitic rocks cut them both. The character of this area of mixed rocks can be made plainer by describing some selected illustrative outcrops or local areas, as follows.

A number of narrow strips of Julian mica schist occur in granite or granodiorite along the road for a mile northward from the Buckman Springs body of Viejas gabbro-diorite. The northern (border) part of the gabbro-diorite body is metadiorite involved with some Julian schist, and the combination is cut irregularly by much granite. Farther within the gabbro-diorite body, where it is very massive, there are several lenslike inclusions of the schist, and the gabbro-diorite is here plainly cut by pegmatitic granite. The relations of schist, diorite and metadiorite, and granite and granodiorite are there very clear.

At the foot of the mountain one mile southeast of Buckman Springs biotitic granite (or granodiorite) contains a swarm of sharply defined, oblong metadiorite inclusions ranging to two feet in length. These are believed to be altered fragments of the Viejas gabbro-diorite.

At the gold mine a little west of Descanso, diorite contains a belt of mica schist with some quartzite, and the diorite is sharply cut by small irregular dikes of Descanso granodiorite.

Along the road two miles northwest of Descanso little lenses or bands of quartzite are closely involved with Descanso granite (or granodiorite).

A large exposure in a field two miles north-northwest of Descanso shows interesting relations of granite and metadiorite. Many nearly parallel dikelike masses of biotitic granite cut the metadiorite; numerous small and large, well-defined, lenslike inclusions of metadiorite occur in granite; some zones, each several feet wide, are good examples of banded gneiss resulting from lit-par-lit injection of metadiorite by granite; and at least one zone seems to be a granite-metadiorite assimilation product.

Along and near the main highway between one and two miles northwest of Pine Valley P. O. there are many good exposures of the mixed rocks. Bands and irregular masses of mica schist are cut by, closely involved with, and have often been more or less thoroughly digested by, granite; diorite or gabbro-diorite varying to metadiorite cuts and also contains inclusions of mica schist and quartzite, the combination being cut by pegmatite and pegmatitic granite; and granodiorite locally contains swarms of more or less digested diorite and metadiorite inclusions, with some aplitic dikes cutting the combination.

The mountain area of about one square mile of mixed rocks just north of Cameron Valley consists of highly metamorphosed sedimentary rocks (presumably Julian schist) irregularly cut by considerable masses of diorite (or gabbro-diorite) varying to metadiorite; the schist seems to be more or less lit-par-lit injected with granite (Descanso?); and this combination is cut irregularly by granodiorite and pegmatite dikes which are probably offshoots of the nearby La Posta quartz diorite. The diorite is more foliated close to the schist, and it seems to have partly digested some of the schist.

Near the summit on the state highway between Cottonwood and Cameron valleys, La Posta quartz-diorite, with some pegmatitic facies, very clearly cuts to pieces, and holds inclusions of, diorite (probably Viejas) varying to metadiorite.

The Los Coches Tunnel area mapped as schist-granite-complex consists mainly of biotitic granite which has badly cut to pieces considerable bodies of Julian schist. Because of more or less lit-par-lit injection of schist by granite, crudely banded gneisses often occur, and the granite seems to have been made locally impure by absorption of schist material.

The area of several square miles mapped as a schist-metadiorite-granite complex extending west to north of Jacumba contains many interesting exposures. It shows an exceedingly mixed lot of rocks. After much study they have been interpreted as paraschist and metadiorite intimately cut and more or less lit-par-lit injected by acidic facies of the Descanso granodiorite. The combination is irregularly and much less intimately cut by large masses of La Posta quartz diorite and finally by many large and small pegmatite and granite satellitic dikes of the La Posta quartz diorite. The paraschist (micaceous and sillimanitic) is correlated with the Julian schist, and it is distinctly more lit-par-lit injected than the metadiorite, which latter is probably a facies of the Viejas gabbro-diorite. The metadiorite is usually well foliated and seems locally to have been well digested by the Descanso granite with a resultant development of a fine-grained ''salt and pepper'' nonfoliated rock. Many of the pegmatite and granite dikes lie parallel to the general northwest structural trend of the mixed rocks, but many others form irregular networks.

Gold Mines in the Mixed Rocks

A considerable number of small gold mines occur within, or close to, the middle of the area of the geologic map accompanying this paper. Most of these have been described in a State Mining Bureau Report (Tucker, 1925, pp. 334–349). The present purpose is to discuss certain important geological features of the gold occurrences.

The Descanso Mine is situated just west of Descanso. A shaft has been sunk to a depth of over 200 feet along a series of roughly parallel gold-bearing quartz veins. Free gold is associated with pyrite, marcasite, galena, and pyrrhotite. The veins strike east-west and dip about 70° N. They occur in a mixed lot of country rocks. A belt of Julian schist with a little quartzite, 30 to 40 feet wide and dipping about 70° N., lies within, and is closely involved with a diorite. This combination is cut by small, irregular, acidic (granitic) dikes of the Descanso granodiorite. The veins lie in a sheared zone of the schist-diorite mixture 5 to 10 feet wide. A large body of Descanso granodiorite lies just west of the mine (see map). It seems clear, therefore, that the hot, ore-bearing solutions came from the granodiorite magma during its emplacement.

A dozen or more gold mines and prospect holes are located in the Deer Park and Laguna Mining districts four to six miles north and northeast of Pine Valley P. O., and just beyond the border of the geologic map. The general geological relations at these mines are very much like those at the Descanso Mine. The gold-bearing quartz veins all occur in an area of mixed rocks consisting mainly of Julian schist (and some dioritic rock) cut to pieces by large and small acidic (granitic) dikes of Descanso granodiorite. In the Laguna district most of the veins are in the schist or along schist-granite contacts, while in the Deer Park district they are mostly within the granodiorite masses. The steep-dipping veins are commonly from one to ten feet wide. Here, as at the Descanso Mine, it seems clear that the hot, ore-bearing solutions came from the granodiorite magma. The fact that some of the veins are in the granodiorite (or acidic phases of it) shows that the solutions were given off during a late stage of the magma consolidation.

In view of the above facts, the writer suggests that, in and near the area discussed in this paper, the most likely places to prospect for gold veins are in the various areas of schist-metadiorite and granite or granodiorite mixed rocks.

CENOZOIC ROCKS

Poway Conglomerate (Eocene).

The Poway conglomerate is rather extensively developed in western San Diego County. It occupies several square miles of the region under study just west of El Cajon and north of La Mesa where it forms part of the so-called "mesa." Ellis (1919, pp. 67–68) mapped it in a general way as Tertiary, tentatively correlating it with the San Diego (Pliocene) formation. Hanna (1926, pp. 213–215) mapped it in considerable detail in the La Jolla quadrangle and found enough fossils in it to determine its age as Eocene (Tejon). Just west of El Cajon Valley the practically horizontal beds hundreds of feet thick rest upon the Alpine quartz diorite. The formation is described in considerable detail by Hanna.

Table Mountain Formation.

The volcanic rocks north, northeast, and east of Jacumba, and all within four miles of that place, rest to a considerable extent upon moderately consolidated deposits of yellowish to reddish-brown gravels and sands. Various kinds of pre-Cretaceous crystalline rock fragments occur in the formation, pebbles and boulders from 2 to 10 inches in diameter being common. These sediments are rather variable in character, crudely stratified, and gently dipping. They are well exposed in places along the margins of the volcanics (see geologic map) where they show a thickness of 50 to 100 feet or more with bottom not shown. It is here proposed to call these sediments the Table Mountain formation because of the fine exposures in the mountain by that name four miles northeast of Jacumba. The outcrops, high above the floor of Jacumba Valley, are quite certainly only remnants of a deposit which once covered much or all of the Jacumba Valley region and vicinity. The fact that the gravels have been so extensively eroded strongly suggests that they were laid down when the land stood at a much lower level than it does today. Also the facts that the gravel beds four miles northeast of Jacumba lie hundreds of feet higher than those just north of Jacumba, and that the gravel deposits together with their lava caps are somewhat tilted, indicate that the Jacumba region has undergone considerable deformation (probably faulting) since the gravels were laid down.

Fairbanks (1893, p. 79) noted the presence of these gravels and assigned them to late Tertiary time. No fossils have been found in them, however, and they may be of earlier Quaternary age. Because they lie so high near the edge of the great eastern scarp; are brownish and somewhat consolidated; and are overlain by lavas, it is hardly reasonable to regard them as of later age than earlier Quaternary. They are probably of the same age as the nonmarine beds associated with the sedimentary-volcanic series of Coyote Mountain just north of the eastern end of the geologic section of the present paper. The age relations are more fully considered beyond in the discussion of the age of the Jacumba volcanics.

Jacumba Volcanics.

The name "Jacumba volcanics" is here proposed for the extrusive rocks which are excellently exposed in the several areas north to east of Jacumba. At various places, as already mentioned, these volcanics may be seen resting upon slightly consolidated brownish sands and gravels. Most of the volcanics are basaltic lavas representing various flows reaching a total thickness of hundreds of feet. The lava beds are in some cases moderately tilted, an excellent case being the succession of lava flows with a general eastward dip of some 8 to 10 degrees capping Table Mountain hundreds of feet above the surrounding country about four miles northeast of Jacumba. Some volcanic breccias or pyroclastics here occur toward the bottom of the lava beds. It is evident that the volcanic rocks were once much more widespread in the general vicinity of Jacumba, and that they have since been greatly eroded and moderately deformed.

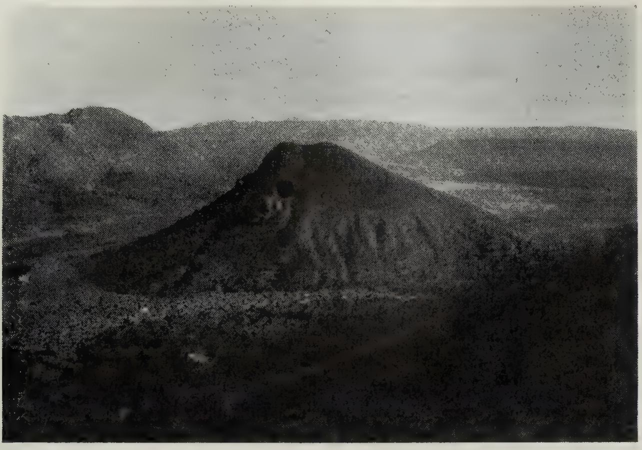

FIG. 8. A cap of late Tertiary or early Quaternary dark volcanic rocks on slightly consolidated, gullied sands and gravels. Round Mountain, two miles northeast of Jacumba.

Under the microscope the rocks are seen to be olivine basalts. A thin section of the rock from the hilltop just north of Jacumba contains by volume percentages: labradorite laths, 66; monoclinic pyroxene (augite?), 20; olivine, 5; secondary calcite, 6; and magnetite, 3. A thin section of the lava from one and one-half miles east of Jacumba contains: labradorite laths, 65; olivine, 10; and indeterminate or glassy groundmass, 25. Both sections show excellent flow structure of the feldspar laths around the considerably decomposed olivine crystals. Both of these rocks are fine-grained and dark gray, as is true of most of the lavas, but some brownish-red vesicular lavas also occur.

A deposit of coarse pyroclastics a hundred feet or more thick and more than a mile long occurs at the base of the mountains four and one-half miles north-northeast of Mountain Spring. It rests upon brownish-gray, moderately consolidated sands and gravels which show a dip of 15 degrees. This pyroclastic deposit is probably of the same, or nearly the same age, as the Jacumba volcanics.

Age Relations

The age of the Jacumba volcanics is not precisely known, but they are at least somewhat younger than the gravels and sands upon which they rest and so they are probably not older than later Tertiary. In view of the fact that they have been so deeply cut into, and so extensively removed by erosion, they can hardly be younger than about middle Quaternary.

A comparison of the Jacumba volcanics and associated sediments with those of Coyote Mountain just north of the end of the geologic section described in this paper throws interesting light upon the age problem. The fossiliferous strata of Coyote Mountain are of upper Miocene or Pliocene age (probably the latter), a discussion of this matter being given by Grant and Gale (1931, pp. 50–51). They rest upon a series of Tertiary volcanics and contain some lava flows. ''Upward the fossiliferous beds grade into a thick series of brackish-water and nonmarine sediments which may represent the remainder of Tertiary and lower Pleistocene time'' (Grant and Gale). These nonmarine beds are light-brown to light-red sands and silts.

The ''Table Mountain'' beds of the present paper immediately underlie the Jacumba volcanics, as in Table Mountain. If these nonmarine beds are of the same age as the marine Coyote Mountain beds, then the age of the Jacumba volcanics is somewhere between the middle Miocene and the middle Quaternary. If, however, the Table Mountain beds correlate with the upper, nonmarine Coyote Mountain sediments, the Jacumba volcanics are of late Tertiary or early Quaternary age. After having seen the nonmarine beds and associated volcanics of both regions, the writer believes that the latter interpretation is very likely correct.

Diabase Dike.

A diabase dike one and one-half feet wide sharply cuts Descanso granodiorite at a high angle by the state highway one mile southeast of Descanso. It is a black, very fine-grained compact rock. Under the microscope it contains by volume percentages: labradorite, 68; hornblende (much chloritized), 20; biotite, 10; magnetite, 1.5; and pyrite, 0.5. The texture is somewhat ophitic, and the very fine-grained groundmass contains some very small phenocrysts of labradorite and hornblende.

No dike similar to this was found elsewhere in the region studied. It probably represents a dike offshoot from the magma which gave rise to the Jacumba volcanics.

Gray Gravels (Late Quaternary).

Along and near the base of the mountains, west of Coyote Wells, there are rather extensive deposits of more or less distinctly bedded gravels and sands often containing somewhat rounded boulders. They have a general eastward dip of about 15 degrees. From just north of the state highway these gravels, hundreds of feet thick, extend several miles south-eastward lying upon and against the quartz diorite of the mountainside. They have been considerably eroded. An erosional remnant of these gravels forms an isolated hill 200 feet high just north of the railroad (see map).

These gravels were carried by swift streams from the adjacent mountains and deposited as alluvial fans in relatively late Quaternary time, since when they have been, and are being, eroded.

The Linda Vista Quaternary terrace gravels, which are so extensively developed east of San Diego, come into the area mapped for this report just west of La Mesa.

MINERAL SPRINGS

The two most important mineral springs in the region mapped in connection with this paper are Jacumba Hot Springs at Jacumba, and Buckman Lithia Springs at the north end of Cottonwood Valley.

At Jacumba the springs include ''several that yield waters with temperature ranging from 86° to 98° F. Total yield is about 15 gallons per minute. These thermal waters are regarded as medicinal, and a bath house and other accommodations are provided'' (Tucker, 1925, p. 382). The water contains some sulphureted hydrogen. ''Though no fault is mapped as passing near these springs, local faulting, which is indicated by the effect of earthquakes at this place, suggest that deep fracturing of rocks here permits the escape of thermal water. The springs are only a half a mile beyond the southern boundary of a small area of lava, however, whose presence suggests another cause for the existence of thermal springs in this region'' (Waring, 1915, p. 45). The fact that similar springs occur several miles southeast of Jacumba, combined with topographic evidence from the town northwest for several miles, strongly suggests a northwest trending fault running through the town, but the writer has not considered the evidence to be quite strong enough to warrant the mapping of such a fault.

At Buckman Springs there is a group of six small mineral springs with waters at temperatures of 60° to 65° F. ''All of these flows are small, probably less than one gallon a minute, but the water is strongly carbonated and is pleasing for table use'' (Waring, 1915, p. 247). According to an analysis the water contains considerable amounts of sodium chloride, lithium chloride, magnesium bicarbonate, and magnesium sulphate together with other substances. The springs occur practically at the junction of two important faults (see geologic map). and it is almost certain that the waters emerge from a fault zone.

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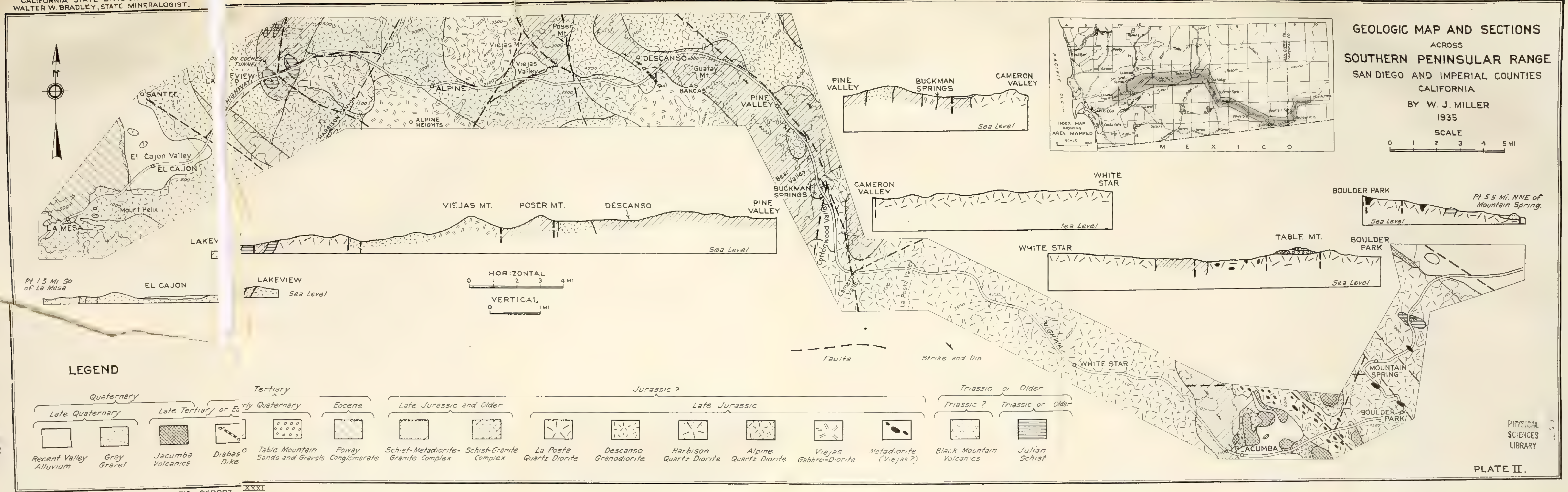

GEOLOGIC MAP AND SECTIONS
ACROSS
SOUTHERN PENINSULAR RANGE
SAN DIEGO AND IMPERIAL COUNTIES
CALIFORNIA

BY W. J. MILLER
1935

SCALE
0 1 2 3 4 5 MI
INDEX MAP SHOWING AREA MAPPED
PACIFIC OCEAN
SAN DIEGO
M E X I C O
SANTEE
El Cajon Valley
EL CAJON
Mount Helix
LA MESA
LAKEVIEW
LOS COCHES TUNNEL
HIGHWAY
HARBISON CANYON
ALPINE
ALPINE HEIGHTS
Viejas Mt
Viejas Valley
Poser Mt
DESCANSO
Guatay Mt
LAS BANCAS
PINE VALLEY
Bear Valley
BUCKMAN SPRINGS
Cottonwood Valley
Cameron Valley
La Posta Valley
WHITE STAR
MOUNTAIN SPRING
BOULDER PARK
JACUMBA
Faults
Strike and Dip
VIEJAS MT.
POSER MT.
DESCANSO
PINE VALLEY
Sea Level
Pt 1.5 Mi So of La Mesa
EL CAJON
LAKEVIEW
HORIZONTAL
0 1 2 3 4 MI
VERTICAL
0 1 MI
BUCKMAN SPRINGS
CAMERON VALLEY
CAMERON VALLEY
WHITE STAR
BOULDER PARK
Pt 5.5 Mi. NNE of Mountain Spring
WHITE STAR
TABLE MT.
BOULDER PARK
LEGEND
Quaternary
Late Quaternary
Recent Valley Alluvium
Gray Gravel
Late Tertiary or Ea
Jacumba Volcanics
Diabas Dike
Tertiary
rly Quaternary
Table Mountain Sands and Gravels
Eocene
Poway Conglomerate
Jurassic ?
Late Jurassic and Older
Schist-Metadiorite-Granite Complex
Schist-Granite Complex
Late Jurassic
La Posta Quartz Diorite
Descanso Granodiorite
Harbison Quartz Diorite
Alpine Quartz Diorite
Viejas Gabbro-Diorite
Metadiorite (Viejas?)
Triassic or Older
Triassic ?
Black Mountain Volcanics
Triassic or Older
Julian Schist

PLATE II.

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ACCOMPANYING STATE MINERALOGIST'S REPORT XXXI

NEW TECHNIQUE APPLICABLE TO THE STUDY OF PLACERS

By OLAF P. JENKINS, Chief Geologist

OUTLINE OF REPORT

Page

ABSTRACT 144

INTRODUCTION 145
- Object of the Report 145
- Significance of Improved Exploration Methods 146
  - I. Aerial Photography 147
  - II. Geophysical Surveying 147
  - III. Physiography 147
  - IV. Study of Desert Processes 148
  - V. Stream Sedimentation 148
- Usefulness of Contouring an Ancient Surface 149
- Provinces of the Ancient Channels in California 152
- Economic Significance of the Tertiary Gravels 154
- History of Development 155

CLASSIFICATION OF PLACERS 156
- Outline of Classification 156
- General Statement 156

CHARACTERISTICS OF THE PRINCIPAL TYPES OF PLACERS 157
- Residual Placers 157
- Eluvial Placers 158
- Stream Placers 159
- Glacial-stream Placers 161
- Bajada Placers 161
- Eolian Placers 162
- Beach Placers 163

PRESERVATION OF PLACERS 165

MODIFICATION OF PLACER DEPOSITS 167

GOLD IN PLACERS 168
- Original Source of Gold 168
- Release of Gold from Bedrock 169
- Associated Minerals 170
- Transportation, Deposition, and Retention 171
- Factors of Concentration 174

AGE OF PLACERS 177
- Significance 177
- Structural Criteria 177
- Paleontologic Criteria 177
- Physiographic Criteria 179
- Lithologic Criteria 179
- Coordination of Criteria 180

LIFE HISTORY AND HABIT OF STREAMS 180
- Need for Scientific Background 180
- Stream Erosion 181
- Preparation of Material Removed by Erosion 181
- Transportation 182
- Deposition 184
- Physiographic Terms Relating to Streams 186
- Desert Processes 191
- Need for Establishment of Working Criteria 192

GEOLOGIC CONDITIONS IN THE GOLD PROVINCES OF CALIFORNIA 193

CONCLUSION 199

BIBLIOGRAPHY OF CALIFORNIA PLACERS 201

ABSTRACT

The exploration of placers is a problem involving nearly all phases of the science of geology, especially physiography and stream sedimentation, neither of which has been given sufficient consideration in connection with the economic problems concerned. The use of aerial photography is a great aid in the study of placers, both ancient and modern. The use of geophysics, when applied as a part of a geologic program of exploration, can materially assist in guiding drilling operations and underground prospecting, with the result that the cost of expensive development work can be greatly reduced and hastened to an earlier completion.

Placers are classified according to the way they are formed: residual, eluvial, stream, glacial-stream, bajada, eolian, and beach. Since the ordinary stream placer is by far the most important, various phases of stream study are discussed in this paper. A need for further scientific study and the development of systematic working criteria is apparent.

The depleted placers of California consist largely of Recent and Pleistocene stream gravels and uncovered or buried, but easily accessible Tertiary channels, while the large reserves lie in more remote positions. These are exemplified by hidden buried bench gravels not connected with the surface nor with channels already worked, and by the lower untouched channels that lie on true bedrock beneath the 'false bedrock' of the dredged areas along the western foot of the Sierra Nevada. Some Pleistocene gravels still lie in pockets beneath the waters of the larger rivers where faults have caused down-

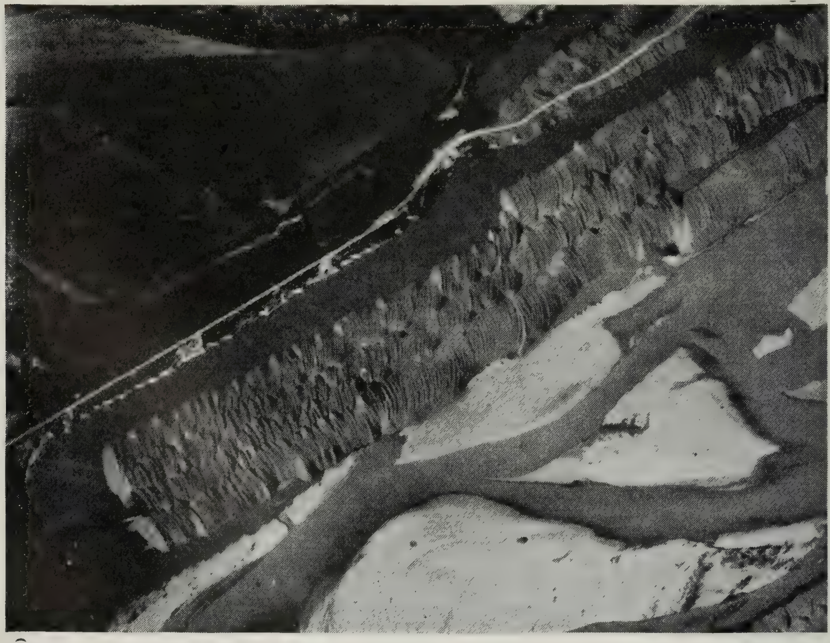

FIG. 1. Aerial photograph of a dredged strip along the Yuba River. Note the dredge at work. *(Photo by Russel, reprinted from E. & M. J.)*

dropping of the stream bed. Benches still lie in isolated regions such as the Klamath Mountains. The desert affords several types of deposits: stream placers buried by alluvial fans, reworked older placers, gravels interbedded with lavas, and the more recent bajada placers. Marine placers of Cretaceous, Eocene, Pleistocene, and Recent periods exist in the state, which may in places be worth investigating.

The largest of all these possible reserves in California probably lies in the remaining buried Tertiary stream channels of the Sierra Nevada.

INTRODUCTION

Object of the Report

The gold-bearing gravel deposits or *placers* of California that still remain untouched lie, for the most part, in more obscure positions than the depleted gravels which formerly produced vast wealth for the state. The depleted gravels, which were once readily accessible but are now nearly mined out, fall into three principal classes:

Depleted Placers.

1. Recent and Quaternary stream gravels.
2. Uncovered channels of Tertiary age.
3. Buried Tertiary channels, easily located.

About one billion dollars worth of gold came from these three sources, the first having produced twice as much as the other two put together.

The placers which still remain to be sought out and worked, offer a challenge to the ingenuity of the exploration geologist. The problems involve the following types of deposits:

Placer Reserves.

1. Deep gravel deposits lying immediately beneath several large rivers, such as the Feather and Klamath.
2. Isolated high benches such as those found in the Klamath Mountains.
3. Ancient gravels that lie beneath 'false bedrock' (interbedded volcanic layers) of the dredging areas along the western foot of of the Sierra Nevada.
4. Gold-bearing gravels occurring in the 'shore' deposits of the Ione (Eocene) formation, and the Chico (Cretaceous) formation.
5. Buried Tertiary channels and associated benches located in the known gold-bearing districts of the state.
6. Buried Tertiary channels and benches in the lava-covered district which lies between the Sierra Nevada and the Klamath Mountains.
7. Bajada placers, or desert alluvial-fan deposits, where gold is derived directly from the original mineralized bedrock source.
8. Desert placers, where the gold is reconcentrated from more ancient gold-bearing streams.
9. Buried desert stream placers.

The scope of these problems indicates the great need of an understanding of the geological principles involved. In no kind of mining is geology more applicable than in the exploitation of these more obscure placer deposits. For this reason, the following discussion is written.

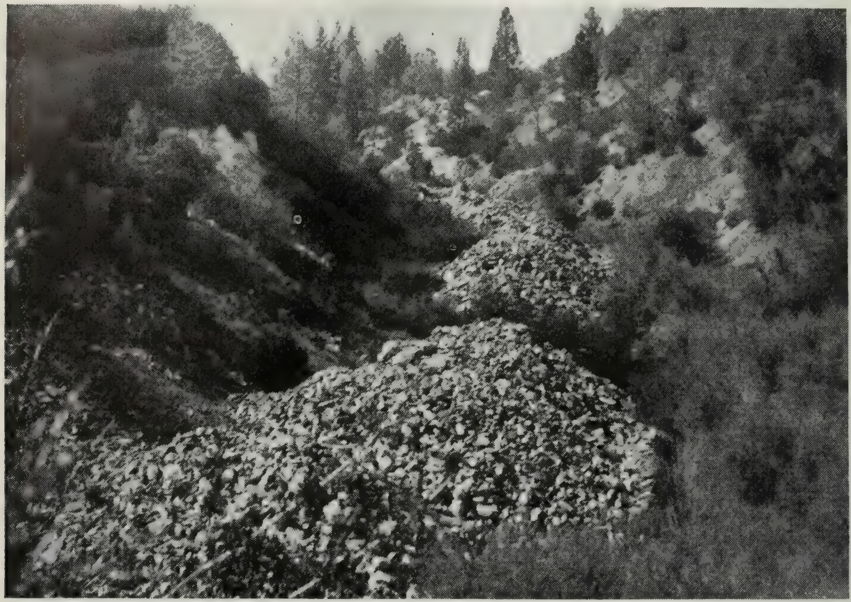

FIG. 2. A mined-out segment of the Tertiary Central Hill channel, near Murphy, Calaveras County. White rhyolitic ash, which covered this channel, is exposed on the left. *(Photo by Jenkins.)*

Significance of Improved Exploration Methods

A widespread geologic study of the ancient Tertiary gold-bearing stream channels of the Sierra Nevada, the gravel deposits of which are found to a large extent buried beneath a mantle of volcanic materials, was concluded by the United States Geological Survey a quarter of a century ago. Lindgren's "Tertiary Gravels"[1] summed up, in a splendid manner, in 1911, these various geologic studies. His data were drawn from his own careful observations, from those of his associates, H. W. Turner, F. L. Ransome, and J. S. Diller (issued largely in folio form), and from such early sources as J. D. Whitney, W. H. Storms, and Ross E. Browne.

Lindgren's Colfax folio,[2] published in 1900, was the last great detailed field study of this kind in the Sierra Nevada. By no means, however, is this folio confined to the subject of stream channels, for it deals with every phase of the geology of the quadrangle. Everything of importance which it was possible to accommodate on a map of the small scale used—two miles to the inch—was recorded. At the time this field work was done, the best equipment and finest technique of the day were employed, and very little escaped Lindgren's keen observation, each feature being scrutinized and shrewdly interpreted by his masterful mind.

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[1] Lindgren, W., The Tertiary Gravels of the Sierra Nevada of Calif.: U. S. Geol. Survey, Prof. Paper 73, 1911.

[2] Lindgren, W., Colfax folio (No. 66.): Geol. Atlas U. S.: U. S. Geol. Survey, 1900.

Since then, however, considerable advance has been made in exploration technique; other and different points of vantage are now available; and a greater degree of refinement of study is therefore in order. Furthermore, mining itself has many advantages today over the earlier methods. With the recent enormous advances in development of motive power, pumps, and other machinery, the drift-mining industry could easily undergo a greatly accelerated development, if guided by intelligent exploration carried on in advance of the attempt to extract 'pay' gravel.

I. Aerial Photography.

From the air, regional photographs are systematically taken by qualified aerial photographers.[3] The pictures are then examined under the stereoscope, or used in constructing topographic maps[4] which show the most amazing completeness of detail. Many surface features never before realized are thus simply unfolded before the eye. Geologic truths in great numbers are revealed, and many important problems solve themselves. Used as a base for location of field observations and surface mapping, these aerial photographs are unexcelled. They are undoubtedly the greatest practical aid which has yet reached the hands of the geologist; besides they give secrecy, speed, and low-cost surveying to the program of modern exploration.

II. Geophysical Surveying.

Added to this regional view from the air is the greater insight into the very interior of the earth itself afforded by several types of geophysical instruments, now well-tried and standardized. Peculiar characters of rock structure and composition are not only revealed but measured with precision by skillful engineers.* Since the proper interpretation of all results thus obtained requires sound geologic reasoning, it is important that a better and more detailed background of geology should be drawn, and this is made more effective by aerial photography.

III. Physiography.

The subject of physiographic geology or *geomorphology* has in recent years made notable progress in developing sound, scientific principles concerning the history and origin of the present surface configuration of the earth. Since these principles are directly applicable

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[3] Lee, Willis T., The face of the earth as seen from the air, a study on the application of airplane photography to geography: Am. Geog. Soc., Special Publ. No. 4, 1922.

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[4] Haquinius, Eric, and Shuster, E. A., Fr., Construction and operation of the Hugershoff Aerocartograph: U. S. Geol. Sur., Section of photo-mapping, 1929.

* The State Division of Mines plans to publish a paper on the use of geophysics in the exploration of placers, the manuscript of which is now in preparation by Mr. W. Quinby Wright of Sausalito, California.

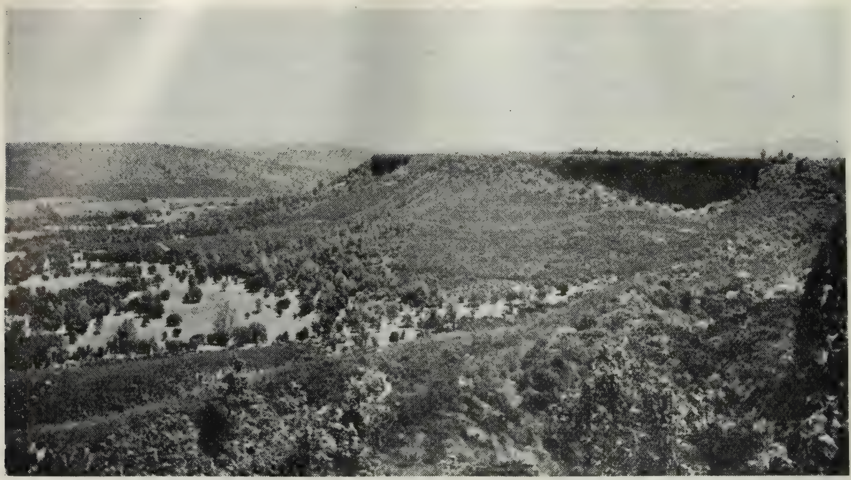


FIG. 3. View of Table Mountain, Tuolumne County, looking northeast, showing how this resistant lava flow, which filled a canyon cut in earlier volcanic materials, now stands out in relief, while the surrounding country is eroded from its sides. (*Photo by Burt Beverly.*)

to the more ancient earth surfaces of the Sierra Nevada, over which flowed the Tertiary streams now extinct, *Tertiary physiography* is the key to the ancient channel problem.

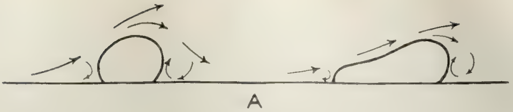
IV. Study of Desert Processes.

Recent study of the geologic processes at work in the desert has led to a better understanding of the desert placers, which offer a practically virgin field for exploration, holding a potential wealth not yet known.

V. Stream Sedimentation.

Furthermore, the study of sedimentation has now reached a refined stage of development. There are today available various methods of technique which may be, but have not yet been, extensively applied to stream deposition. This sort of research includes the critical study of texture and structure of strata, as well as the microscopic examination of their mineral grains. It should yield a wealth of practical information concerning the processes involved in the accumulation of gravels, in the nature and direction of stream flow, in knowledge of what to expect as regards the concentration of gold and other heavy minerals, and in the correlation of channels of the same period or of the same system.

The more obvious criteria of stream sedimentation have long been used by the experienced miner, who, by examining the gold particles under the simple hand lens, infers whether they were robbed from earlier channels or whether they came directly from a vein. Also he uses the 'shingling' of gravels to tell him the direction of stream flow. These and a few other working criteria now used by the miner, however, have not all undergone a thorough scientific test, and at present there is a wide difference of opinion as to their interpretation.



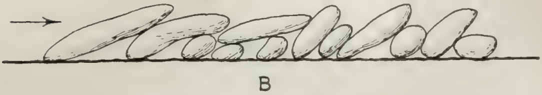


FIG. 4-A. Diagram to show effect of stream-bed irregularities on water current. *(After Chamberlain & Salisbury.)*

FIG. 4-B. Diagram illustrating 'shingling.' The arrow points in the direction of stream flow. This arrangement of flat stones may be found in the bed of a mountain stream and is used by the drift miner to tell which way the ancient stream was flowing at that particular point. *(After Geike, originally from Jamièson, T. G., Quat. Jour., G. S. Lon. vol. 16, 1860.)*

The advances in technique and sound geologic interpretation should, therefore, be made to serve as wide practical aids in channel exploration, and much more definite and conclusive results should be gained now than were possible 25 years ago. Since it is well known that many channels still lie buried, undoubtedly containing a potential gold wealth not yet half exhausted, why should not new discoveries now be made if the new technique in placer exploration is employed?

Certainly the more advanced methods of technique in exploration were called upon by the petroleum industry, resulting in the flooding of the country with oil. Now the application of some of the same methods is taking a leading part in various types of mining, bringing further success to other mineral industries. If the gravel mining industry takes full cognizance of the importance of the new exploratory methods of the science, successes for it should indeed be assured.

Usefulness of Contouring an Ancient Surface

The most elucidating method of tracing in detail and showing graphically the position and course of an ancient stream valley is by preparing a contour map [5] of the old drainage surface. The contours may be superimposed over a base map which should also show the present surface topography and areal distribution of the geologic formations, as well as any mine workings, drill holes, etc.

With the old surface contours superimposed on the present surface contours, an accurate estimate may be made of the thickness, extent, and yardage of the intervening channel-filled area. The points which are to be used in preparing an old-surface contour map should be secured through careful study of geologic and physiographic conditions, and obtained during the surface and underground survey. Drill-hole data and the essential results of geophysical observations should also be represented on this map. Careful enough study should be made so that the points used represent only one period of erosion.

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[5] Lindgren, W., The gold-quartz veins of Nevada City and Grass Valley districts, California: U. S. Geol. Sur., 17th An. Rept., Pt. 2, 1896. (Contour map of the Neocene bedrock surface.) Plate II.

If the geologic work is done prior to a contemplated geophysical survey and drilling program, much time and money may be saved in the location and number of points of observation, as well as in the number of drill holes needed. An approximate old-surface contour map may generally be constructed as a preliminary step by a skillful geologist, though he is limited only to surface data. This map should locate the general trend of the ancient valley to which later detailed work should be confined, thus eliminating much unnecessary and more costly work in adjoining areas unlikely to be productive. The most accurate elevations are those taken on bedrock where it is in direct contact with the older gravels, or with the pipe-clay and other volcanic materials of the oldest period of the area. Thus geological investigation should limit the extent of the geophysical work, which in turn defines the area to be drilled and later to be explored by underground methods.

The basis for such mapping may effectively be prepared as part of a plane-table survey of the surface topography and geology. Aerial photography, however, has now become an almost indispensable aid to such work. Enlarged aerial photographs may be used as plane-table sheets, thus adding to the final map an enormous amount of useful information and physiographic detail.

Provinces of the Ancient Channels in California

The so-called 'buried channels' occur for the most part in the northern Sierra Nevada, where, during the Tertiary period, millions of years ago, volcanic outbursts with their mud-flows, covered the then existing network of stream courses. Thus entrapped and preserved, this old surface of the earth, probably Eocene in age, with all its forest-covered hills, beautiful valleys, and winding streams laden with gold, became completely hidden. Not until the area was lifted by mountain-making forces did the later rivers cut their canyons through the heavy mantle and expose whatever was beneath it. But even then, further volcanic mud-flows, cobble-washes, and newer streams of lavas, filled and refilled the valleys formed. Finally, modern canyon-cutting trenched the whole area deeply, leaving remnants of flat-topped ridges between.

Though no volcanic mantle ever covered the ancient streams of the Klamath Mountains, the region was uplifted in late Tertiary and Quaternary times, and the rivers were therefore entrenched. As a result, benches of gravel were left at various elevations along the sides of the canyons. Faulting also played an important role in the history of the uplift, trapping gold-bearing gravels which date back to the Eocene.[6] The whole subject of the surface features of the region, past and present, represents a series of very interesting problems not yet entirely solved, though they are now being carefully studied.[7]

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[6] Hinds, Norman E. A., Mesozoic and Cenozoic eruptive rocks of the southern Klamath Mountains, California: Univ. Cal. Publ., Bull. Dept. Geol. Sci., vol. 23, 1935, p. 368.

[7] A paper on this subject is in preparation by Dr. N. E. A. Hinds, Department of Geology, University of California.

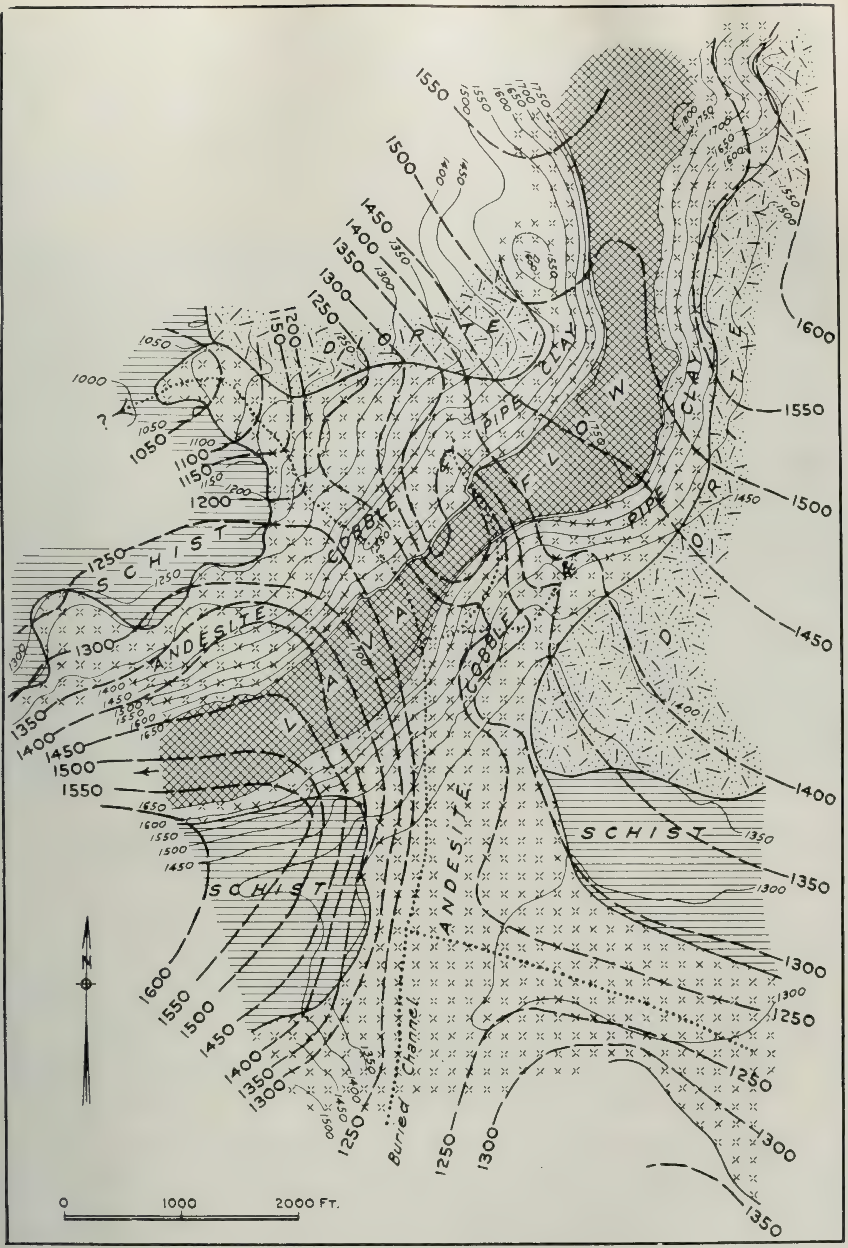

FIG. 5. Example of a geologic map showing the earlier prevolcanic topography in contrast with the present topography. Old-surface contours (dashed lines) are drawn over present-surface contours (fine, full lines). A major early Tertiary valley is thus reconstructed, and the general position of its buried stream channel is indicated, lying beneath volcanic materials of two later geologic periods, i.e., (1) Miocene cobble and pipe-clay (mud-flows and lake beds), (2) Pliocene lava flow which followed a canyon cut in the andesitic materials. The older channel cut in bedrock is gold-bearing. Its course was controlled by bed-rock, for it followed the contact between hard diorite and softer schist. The gradient of the lava flow is not as steep where it is directed south as where it turns towards the west. This is explained by the westward tilting of the Sierra Nevada.

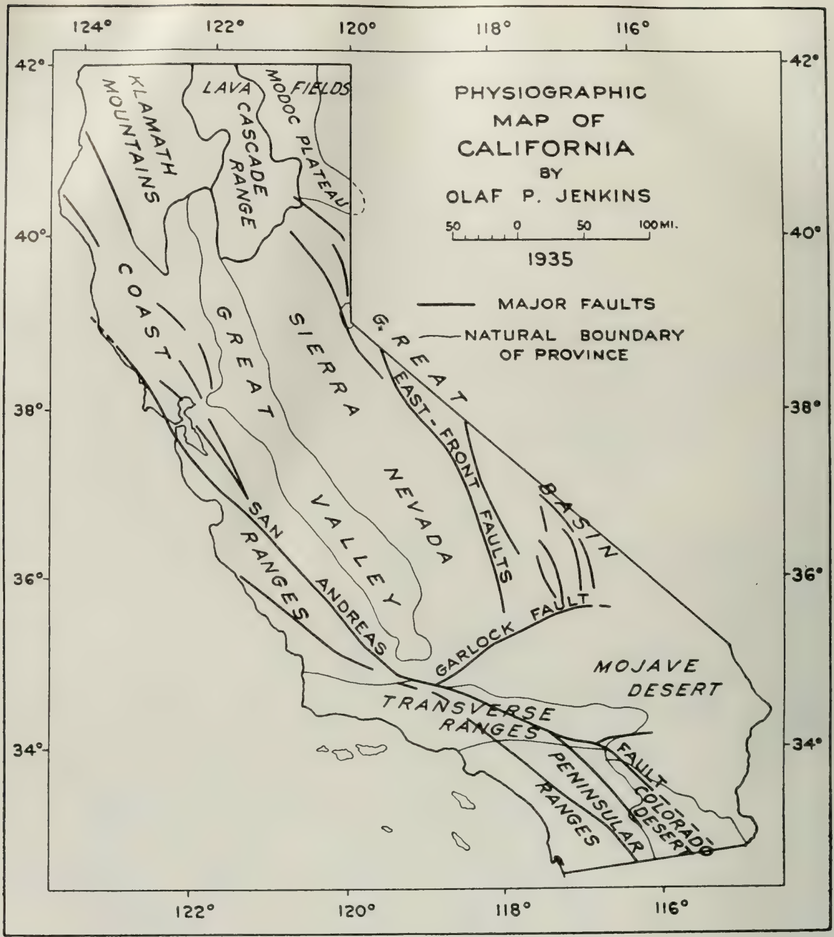
PHYSIOGRAPHIC MAP OF CALIFORNIA
BY
OLAF P. JENKINS
50 0 50 100 MI.
1935
MAJOR FAULTS
NATURAL BOUNDARY OF PROVINCE
124°
122°
120°
118°
116°
42°
40°
38°
36°
34°
KLAMATH MOUNTAINS
LAVA FIELDS
MODOC PLATEAU
CASCADE RANGE
COAST
RANGES
GREAT VALLEY
SIERRA NEVADA
GREAT
BASIN
EAST-FRONT FAULTS
SAN
ANDREAS
GARLOCK FAULT
MOJAVE DESERT
TRANSVERSE RANGES
FAULT
PENINSULAR RANGES
COLORADO DESERT

Fig. 6. Map of California, showing the principal physiographic provinces and the major faults or fault zones of the state. The principal gold provinces occur in the northern Sierra Nevada, the Klamath Mountains, the Great Basin, and the Mojave Desert. Gold has been mined in the Peninsular Ranges, and a small amount has been found in the southern Coast Ranges. It was first discovered in 1834 in the Transverse Ranges east of Los Angeles; but not until James W. Marshall's discovery on the American River in the foothills of the Sierra Nevada, January 24, 1848, did the occurrence of gold in California become significant.

In the Mojave Desert,[8] Tertiary gold-bearing streams may have once flowed south from the region which is now the Sierra Nevada; but during the Pleistocene period their deposits became so broken and disrupted by faulting, and so extensively covered by later desert wash, that now there remains little to be easily recognized or traced.

The problem of the 'dry placer' is one of considerable importance, and when more is learned about it, an immense potential gold wealth may be discovered which has not yet been glimpsed. At present, the lack of water [9] is largely responsible for limited operations. It is quite possible, however, to find and develop a sufficient underground water supply in many places for dredging operations. The finding of such water supplies may also be greatly assisted through the use of geological knowledge and geophysical surveying.

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[8] Hulin, C. D., Geologic features of the dry placers of the Northern Mojave Desert: State Mineralogist's Rept. XXX, 1934, pp. 417–426.

[9] Simpson, E. C., Geology and mineral deposits of the Elizabeth Lake quadrangle, California: State Mineralogist's Rept. XXX, 1934, p. 409.

In the Peninsular Ranges of San Diego County, some placers have been mined. In the Poway (Eocene)[10] marine conglomerate is found the Ballena placer,[11] described as early as 1893.

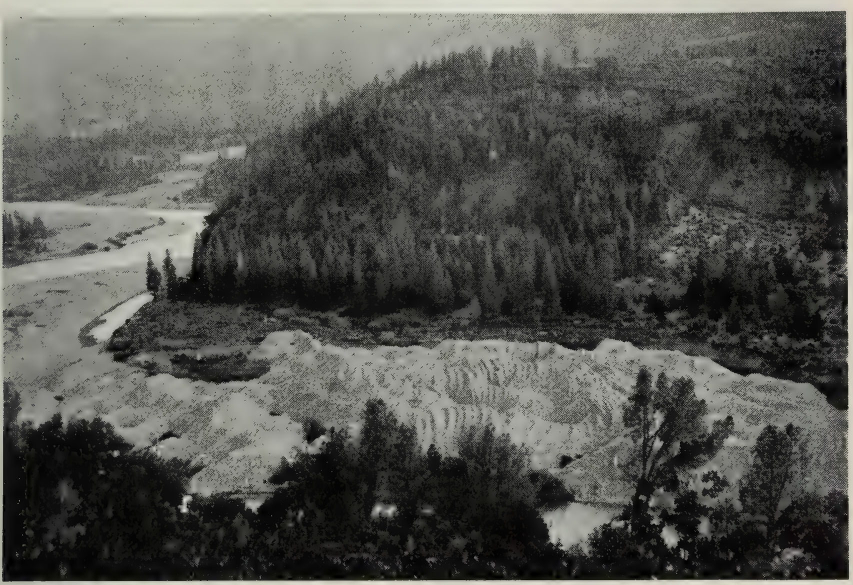

FIG. 7. Old work of the Valdoro Dredging Company in the bed of the Trinity River, Junction City. Bench gravel exposed on the opposite side of the canyon shows the effect of early hydraulic mining. *(Photo by Jenkins.)*

Economic Significance of the Tertiary Gravels

Lindgren[12] in 1911, made the statement that "about $300,000,000 is a conservative guess for the amount obtained from the Tertiary gravels," including hydraulic, drift, and other forms of placer mining. Just how much has been taken from the buried channels by underground methods, alone, is difficult to determine. J. M. Hill[13] states:

> "Drift mining on the ancient buried channels was started at Forest Hill, Placer County in 1852 and was an important source of placer gold, by 1866. During the period beginning about 1876 and continuing to about 1890, drift mining was most productive."

From 1848 to 1933 California's gold production amounted to nearly two billion dollars, of which one and a quarter billion came from placer gravel. The ratio of gold produced from placers to gold produced from lodes is shown in the following table:

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[10] Donnelly, Maurice, Geology and mineral deposits of the Julian district, San Diego County, California: State Mineralogist's Rept. XXX, 1935, p. 369.

[11] Merrill, Frederick J. H., The counties of San Diego, Imperial: State Mineralogist's Rept. XIV, 1913–1914, p. 652.

Fairbanks, H. W., Geology of San Diego County; also portions of Orange and San Bernardino counties: State Mineralogist's Rept. XI, 1893, p. 91.

[12] Lindgren, W., The Tertiary gravels of the Sierra Nevada of Calif.: U. S. Geol. Survey, Prof. Paper 73, 1911, p. 81.

[13] Hill, J. M., Historical summary of gold, silver, copper, lead, and zinc produced in Calif., 1848 to 1926: U. S. Bur. Mines, Econ. Paper 3, 1929, p. 6.

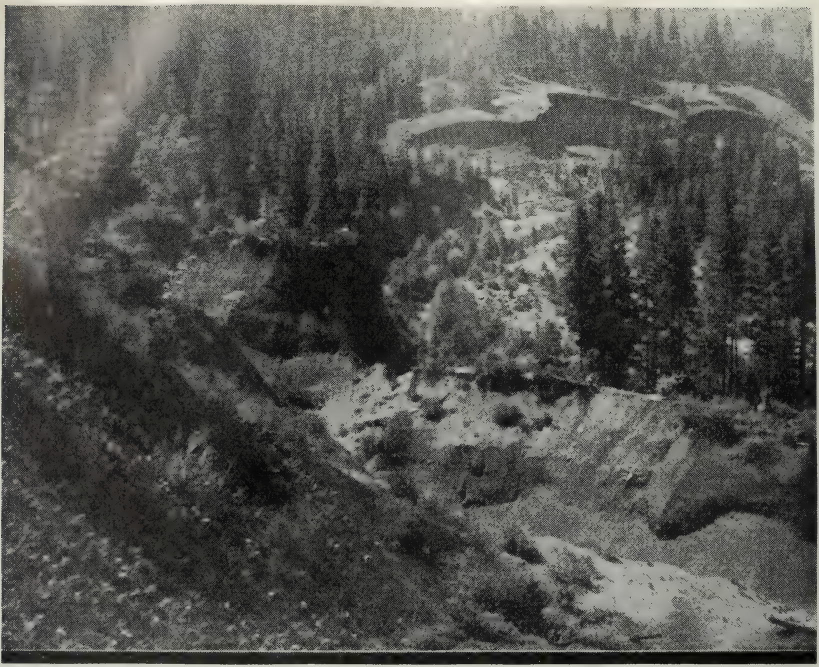

FIG. 8. Ancient river terraces of Canyon Creek, tributary of the Trinity River, partly hydraulicked. *(Photo by Jenkins; cut by courtesy of E. & M. J.)*

Ratio of Placer Production to Lode Production

Period	*Per cent*	*Period*	*Per cent*
1848 to 1850	100	1891 to 1900	20
1851 to 1860	99	1901 to 1910	35
1861 to 1870	90	1911 to 1920	44
1871 to 1880	70	1921 to 1930	44
1881 to 1890	25		

The decline in this ratio was caused by the closing down of hydraulic mines by the Sawyer Decision of 1884 together with the Caminetti Act of 1893, as well as by the increased development of lode mining. The later increase of the ratio was due to the use of the dredge, which was introduced in California in 1898.

Haley [14] has estimated that "In the neighborhood of $600,000,000" worth of gold (on the basis of the old price) is still recoverable from the old Tertiary channels, referring to both hydraulic and drift-mining properties. There are undoubtedly many unaccounted-for channels, such as those that lie buried beneath the extensive lava flows which occur in the region lying between the Sierra Nevada and Klamath mountains. Though most of these are not today available for mining, the channels along the margin of this area may some day be reached. It is conceivable, however, that the reserves in buried channels throughout the Sierra Nevada, workable only through underground methods, should be reckoned at least in terms of hundreds of millions of dollars.

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[14] Haley, C. S., Gold placers of California: Cal. State Min. Bur., Bull. 92 1923, p. 5.

The economic significance of the buried channel and the importance of its exploration should not, therefore, be slighted, for it represents a vast future source of gold wealth for California. The revival of the channel-mining industry is made still more interesting by an understanding of the detailed geologic features, the possibilities they suggest for certain of these buried stream courses, and the realization of the vast extent of the region yet to be explored.

Since an estimate of the potential wealth of the desert placers depends upon further exploration and mining of them, it is not yet possible to evaluate their place in this study.

History of Development

The discovery of the Tertiary channels followed shortly after the discovery of gold in the present stream courses. In places, remnants of Tertiary channels were found lying exposed high up on 'flats,' stripped of their volcanic covering by Pleistocene erosion. Starting from these flats, the miners followed the uncovered channel to the point where it was covered by the lava capping, the top of which formed another kind of 'flat.' Water was nearly always encountered, which led to the construction of long and expensive drainage tunnels. To place these tunnels at the proper elevation to serve their best purpose was the most serious problem, for the old-timers did not have the powerful pumps which we use today.

The ideas developed concerning the courses and positions of the ancient channels were many and varied. Misconceptions of Tertiary physiography led many persons astray, and millions of dollars were spent in vain. In spite of the millions gained, the losses were so great as to stamp this form of mining as hazardous in the extreme.

It is most instructive to follow carefully the recorded history of mining in a given district and to consider its relation to the geologic condition of that area. The two are so closely related as to provide a guide to the probable history which might be expected to be found in another area if the geology were known, or *vice versa*; the recorded history reflects what geologic conditions may be expected.

The geologic history and structure of the buried channels are so complex that the best of engineers have been baffled by them. Fragmentary benches and segments of rich gravel deposits which still rest in positions completely hidden from the surface, or even from the underground passages which enter into the lower, main channels, afford alluring possibilities to the geologist and geophysicist as well as to the prospector. A three-dimensional surface, complex and irregular in the extreme, is the problem to be faced.

The key to the solution is geology, aided by aerial photography, followed by new geophysical surveying, and finally by directed prospecting through means of the drill, shaft, incline, or tunnel. To be effective, all these methods should be coordinated into one unified exploration program.

CLASSIFICATION OF PLACERS

Outline of Classification

A systematic geological study of placers calls for an orderly classification dividing them into *genetic types,* which indicate how they were first formed. The following classification is based upon the fundamental conditions of deposition:

Fundamental Classification of Placers

A. Residual placers or 'seam diggings.'
B. Eluvial or 'hillside' placers, representing transitional 'creep' from residual deposits to stream gravels.
C. Bajada placers, a name applied to a certain peculiar type of 'desert' or 'dry' placer.
D. *Stream placers (alluvial deposits), sorted and re-sorted, simple and coalescing.*
E. Glacial-stream placers, gravel deposits transitional from moraines, for the most part valueless.
F. Eolian placers, or local concentrations caused by the removal of lighter materials by the wind.
G. Marine or 'beach' placers.

Of these seven types, the ordinary stream placer is by far the most important. All types are, however, more or less interrelated and intergradational; they are all subject to deformation or burial, and they may be formed during any geological period.

Most of these various types of placer deposits have been well described and classified by Brooks,[15] Mertie,[16] and others[17] in their studies of Alaskan geology. Webber[18] recently proposed the name, "Bajada placer" for peculiar desert, or so-called 'dry' placers, which he carefully analyzed. The concentration of gold by the agency of wind in Western Australia has been described by Rickard[19] and Hoover.[20]

General Statement

In valuating a placer, one of the first considerations should be the determination of how it was formed. It is recommended, therefore, that the exploration engineer should classify genetically each gravel deposit to be prospected. This calls for an understanding of the historical geology of the region and of the processes which have been responsible for the formation of the deposit, as well as how it came to be preserved or modified from its original form. The actual sampling of a deposit is carried on in a much more intelligent and satisfactory manner when a clear understanding of the geologic set-up has been acquired.

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[15] Brooks, Alfred H., The gold placers of parts of Seward Peninsula, Alaska: U. S. Geol. Survey, Bull. 328, 1908, pp. 111–139; mineral resources of Alaska, report on progress of investigations in 1913: U. S. Geol. Survey, Bull. 592, 1914, pp. 27–32.

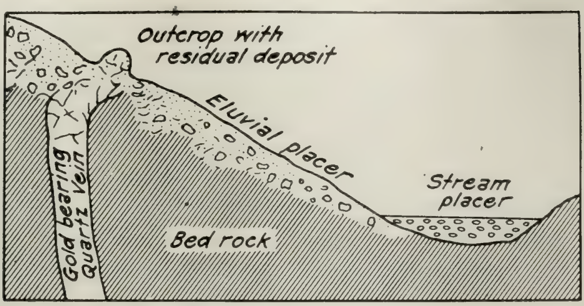
[16] Mertie, J. B., Jr., The occurrence of metaliferous deposits in the Yukon and Kuskokwim regions, U. S. Geol. Survey, Bull. 739, pp. 160–165.

[17] Wimmler, Norman L., Placer mining methods and costs in Alaska: U. S. Bureau of Mines, Bull. 259, 1927 (Classification of placers), p. 11.

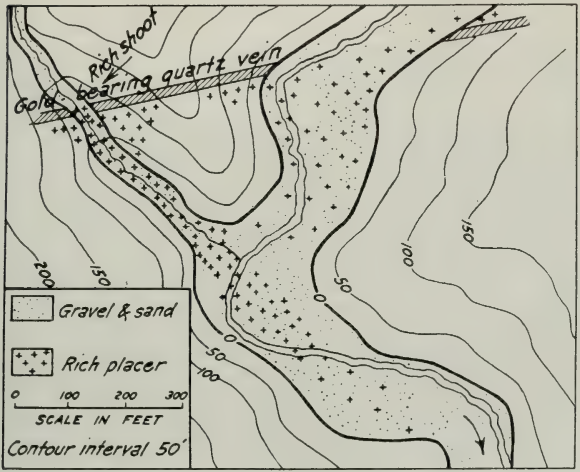
[18] Webber, Benjamin N., Bàjada placers of the arid southwest: Am. Inst. M. and M. Eng., Tech. Publ. 588, 1935, pp. 3–16.

[19] Rickard, T. A., The alluvial deposits of Western Australia: Am. Inst. M. and M. Eng., Trans. vol. 28, 1898, pp. 490–537.

[20] Hoover, H. C., The superficial alteration of Western Australian ore-deposits: Am. Inst. M. and M. Eng., Trans. vol. 28, 1898, pp. 758–765.


Outcrop with residual deposit
Eluvial placer
Stream placer
Gold bearing Quartz Vein
Bed rock

A


Rich shoot
Gold bearing quartz vein
200
150
0
50
100
50
100
150
Gravel & sand
Rich placer
0 100 200 300
SCALE IN FEET
Contour interval 50'

B

FIG. 9-A. Diagrammatic cross-section showing the transitional stages in the development of placer deposits: First, the quartz vein; second, disintegration at the outcrop to form a *residual* placer; third, formation of *eluvial* placer by 'creep' of residual material down the hill slope; fourth, deposition of water-worked material as *alluvium,* forming an auriferous gravel deposit, or stream placer.

FIG. 9-B. Sketch map showing the development of rich placers broken-down directly from the disintegration of a gold-bearing vein. *(After Lindgren, "Mineral Deposits.")*

CHARACTERISTICS OF THE PRINCIPAL TYPES OF PLACERS

Residual Placers

In order that gold may become released from its original source in bedrock, the encasing material must be broken down. This is most effectively done by long-continued surface weathering. Disintegration is accomplished by persistent and powerful geologic agents, which effect the mechanical breaking-down of the rock and the chemical decay of the minerals.

The surface portion of a gold-bearing orebody will become enriched during this process of rock disintegration, because some of the softer and more soluble parts of the rock are carried away by erosion, leaving the remaining portion of higher tenor. The name *residual placer* is applied to this type of deposit. After the residual portion is mined away by comparatively inexpensive methods, the harder mineralized rock is encountered, and the mining methods must be changed to accommodate another type of deposit, i.e., the lode.

The so-called 'seam diggings' are in weathered, gold-bearing quartz stringers, occurring along fracture zones of disintegrated schists.

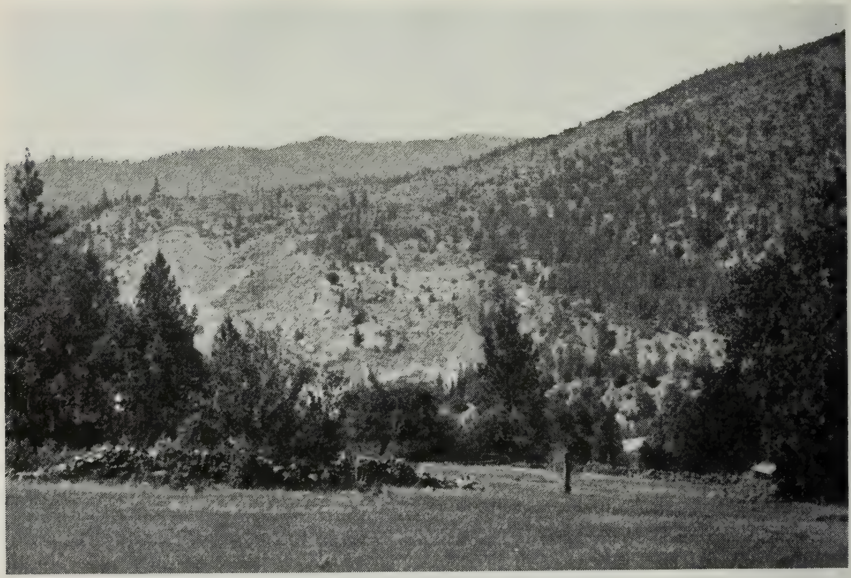


FIG. 10. Quartz Hill Mine, Scott River, Siskiyou County. Disintegrated material formed in the upper part of gold-bearing veins, by residual weathering, has been removed by hydraulic mining. Note the terrace-like profile of the hill, indicating that an older, less rugged surface existed at the time this deep weathering took place. Uplifting of the region entrenched the drainage, and much of the gold released by weathering was washed by Pleistocene erosion into Scott River where rich gravel bars have been mined. *(Photo by Jenkins.)*

Eluvial Placers

After gold is released from its original bedrock encasement through agents of rock decay and weathering, the whole weathered mass may 'creep' down the hillside (in some regions partly because of frost heaving) and may finally be washed down rivulets into gulleys. Lindgren[21] states:

> "When the outcrops of gold-bearing veins are decomposed a gradual concentration of the gold follows, either directly over the primary deposits or on the gentle slopes immediately below. The vein when located on a hillside bends over and disintegration breaks up the rocks and the quartz, the latter as a rule yielding much more slowly than the rocks; the less resistant minerals weather into limonite, kaolin, and soluble salts. The volume is greatly reduced, with accompanying gold concentration. The auriferous sulphides yield native gold, hydroxide of iron, and soluble salts. Some solution and redeposition of gold doubtless take place whenever the solutions contain free chlorine. The final result is a loose, ferruginous detritus, easily washed and containing easily recovered gold. This gold consists of grains of rough and irregular form and has a fineness but slightly greater than that of the gold in the primary vein."

On its way down the hillside, gold is sometimes concentrated in sufficient value to warrant mining. Such deposits are classified as *eluvial placers.* They are transitional between residual and stream, or *alluvial,* deposits.

There have been a number of residual and eluvial gold deposits mined in both the Sierra Nevada and Klamath Mountains; for example, the 'seam diggings' of Georgia Slides,[22] Eldorado County, and Scott Bar,[23] Siskiyou County.

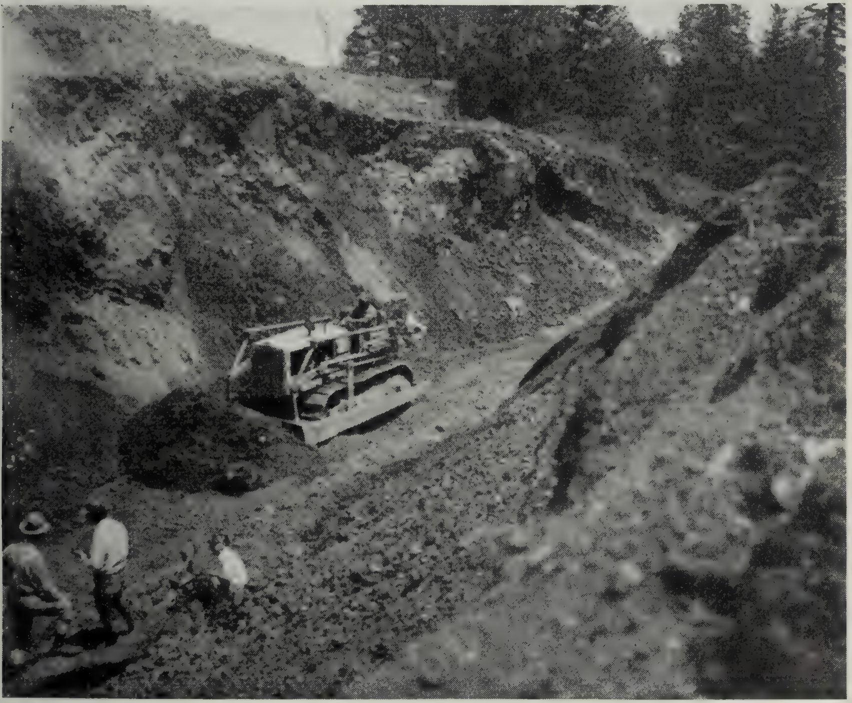


FIG. 11. Residual weathered part of a gold-bearing orebody, King Solomon Mine, Siskiyou County. *(Photo by Walter W. Bradley.)*

Stream Placers

By far the most important type of placer is the ordinary alluvial gravel or stream placer. So far, it has been the source of most of the placer gold mined; but now its supply is nearing depletion, save for values remaining in those ancient channels which lie deeply buried beneath a cover of lava or rock debris.

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[21] Lindgren, W., Mineral Deposits, McGraw-Hill, 1919, p. 213.

[22] Logan, C. A., Mother Lode Gold Belt of California: Cal. State Div. Mines, Bull. 108, 1935, pp. 43–44.

[23] Logan, C. A., Siskiyou County: State Mineralogist's Rept. XXI, 1925, p. 474.

Deposits by streams include those of both present and ancient times, whether they form well-defined channels or are left merely as benches. Stream placers consist of sands and gravels sorted by the action of running water. If they have undergone two or more periods of erosion, and have been re-sorted, the result will in all probability be a comparatively high degree of concentration of the heavier mineral grains.

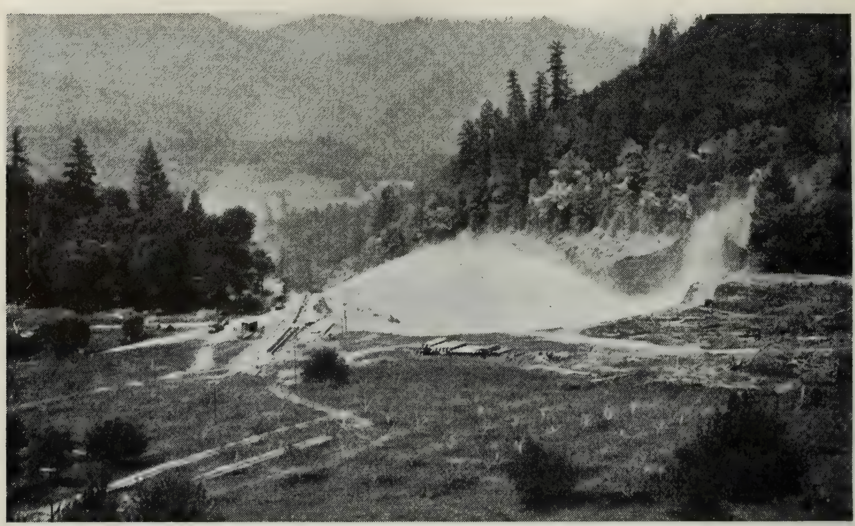

Fig. 12. Hydraulicking a high bench gravel deposit of the Trinity River, near its confluence with the South Fork. Location: Salyer Mines, Pit No. 5. *(Photo by Jenkins.)*

Quoting from Mertie:[24]

> "All bench placers, when first laid down, were stream placers similar to those of the present stream valleys. In the course of time the stream gravels, if not reworked by later erosion, may be left as terraces or benches on the sides of the valley, if the local base-level is lowered and the stream continues to cut down its channel. Such deposits constitute the so-called bench gravels. On the other hand, if the regional or local base-level is raised, the original placer may be deeply buried and a second or later placer deposit may be laid down above it. * * * If the local base-level remains practically stationary for a very long period, a condition seldom realized, ancient and recent placers may form a perfectly continuous deposit in a long valley, for the deposition of a gold placer is known to occur at that point in a valley where the stream action changes from erosion to alluviation, and such deposits are therefore formed progressively upstream.
>
> "Where several parallel and contiguous streams that are forming placers emerge from their valleys upon an open plain, perhaps into some wide valley floor, a continuous or coalescing placer may be formed along the front of the hills. If the streams empty into some lake or estuary, a delta placer, genetically the same but perhaps different in some minor respects, may be formed. Manifestly such compound placers may be formed by either present or ancient streams and may be elevated or buried in the same way as simple stream placers."

In order to understand thoroughly the subject of stream placers, streams themselves must be studied in regard to their habit, history, and character. The effects of existing and changing climates, the relation to surrounding geologic conditions, and the effect of movements of the earth must also be considered. A special chapter in this report has therefore been devoted to a brief outline of the fundamental geologic features of streams.

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[24] Mertie, J. B., Jr., *op cit.*, pp. 161–162.

Glacial-stream Placers

It is a frequent fallacy of the placer miner to attribute the deposition of gold-bearing gravels to the action of glaciers. Contrary to such a belief, glaciers do not concentrate minerals; the streams issuing from melting ice, however, may be effective enough in sorting debris to cause placers to be formed under certain especially favorable conditions. In California, glaciers occurred throughout the high Sierra during the Pleistocene, but in Tertiary times they were wholly lacking. The Pleistocene streams cut through the earlier channels, robbing them of much of their gold.

Quoting from Blackwelder:[25]

> "Since it is the habit of a glacier to scrape off loose debris and soil but not to sort it at all, ice is wholly ineffective as an agency of concentration for metals. Gold derived from the outcrops of small veins is thus mixed with large masses of barren earth. Attempts to mine gold in glacial moraines, where bits of rich but widely scattered float have been found, are for that reason foredoomed to failure.
>
> "If a glacier advances down a valley which already contains gold-bearing river gravel, it is apt to gouge out the entire mass, mix it with much other debris and deposit it later as useless till. Under some circumstances, however, it merely slides over the gravel and buries it with till without disturbing it.
>
> "On the other hand, the streams born of glaciers or slowly consuming their moraines have the power to winnow the particles of rock and mineral matter according to size and heaviness. Such streams may form gold placer deposits in the well-known way by churning the load they carry and allowing the heavy minerals to sink to the bedrock. Placers may therefore be found in the deposits of glacial rivers if there are gold veins exposed in the glaciated area upstream. Nearly all the gravel which has been dredged for gold along the foothills of the Sierra Nevada was deposited by rivers derived in part from glaciers along the crest of the range, but most of the gold was probably picked up in the lower courses of such rivers. Since glacial rivers choke themselves and build up their channels progressively, their deposits are likely to be thicker and not so well concentrated as those of the more normal graded rivers which are not associated with glaciers."

A few gold-bearing deposits in re-worked glacial till may be found along the eastern front of the Sierra Nevada, as, for example, in the region just north of Mono Lake on the road to Bridgeport.

Bajada Placers

The name *Bajada* was first used by Tolman [26] for confluent alluvial fans along the base of a mountain range. Recently Webber [27] named and described the *bajada type* of placer deposit as follows:

> "Bajada is the Spanish term for slope and is used locally in the Southwest to indicate the lower slope of a mountain range, the portion consisting of rock debris and standing at a much lower angle than the rock slope of the range proper. * * *
>
> "The total production of gold from bajada placers in the southwestern United States is necessarily small, probably not over ten million dollars. * * *
>
> "Most all bajada placer gravels are Quaternary and the larger part are recent. * * *
>
> "The genesis of a bajada placer is basically similar to that of a stream placer except as it is conditioned by the climate and topography of the arid region in which the placer occurs. * * *
>
> "Erosion, transportation and deposition in a region of extreme aridity present some phenomena not encountered in more humid areas. Practically all the work of running water is strongly conditioned by aridity. * * *
>
> "Rock-floored canyons through which rock fragments are moved by infrequent torrential floods should constitute excellent pebble mills for the further reduction of the material, but the amount of attrition accomplished seems to be slight, as fragments, large or small, on the bajada slope are decidedly angular and show little effect of attrition. * * * Probably a small percentage of the gold is freed during this phase of the movement of gravel. The gradient of these intermont drainage channels is too high to permit lodgment of the finer gravel. When a small amount

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[25] Blackwelder, Eliot, Glacial and associated stream deposits of the Sierra Nevada: State Mineralogist's Rept. XXVIII, 1932, pp. 309–310.

[26] Tolman, C. F., Erosion and deposition in southern Arizona bolson region: Jour. Geol., vol. 17, 1909, pp. 136–163.

[27] Webber, B. N., *op. cit.*, Excerpts from pp. 3, 4, 6, 8, 10 and 11.

of gravel is temporarily lodged in one of these channels, the deposit displays most of the characteristics of stream gravel.

"As debris reaches the bajada slope a rapid diminution in volume of water due to seepage and an extreme decrease in the grade of channel causes deposition of debris, and either (1) an alluvial fan or (2) a gravel-mantled pediment may be formed. If detritus is supplied to a bajada slope much faster than it can be removed, an alluvial fan is the result. * * * If rock debris is supplied to the bajada slope in considerable volume but not in excess of the quantity capable of transference to the center of the basin by the existing agencies, a gravel-mantle pediment results. * * *

"The bulk of the gold that has been released from its matrix on the journey from lode outcrop to bajada slope is deposited on the bajada slope close to the mountain range. The gold is dropped along the contact of the basin fill and bedrock; this is referred to hereafter as the lag line and is coincident with the line of contact of bajada gravels lying at a low angle and the rock slopes of the range standing at a high angle. * * *

"The heaviest deposition of gold is on bedrock at the lag line, and since the lag line is moving in the direction of the crest of the range, values on bedrock may be distributed over a large area of which the longest dimension is parallel to the foot of the range. Because bulk concentration does not operate as in a river channel, and a certain percentage of the gold is still locked in fragments of matrix, to be partly released by further disintegration on the bajada slope, there is a strong tendency for less gold to reach bedrock and for more to remain erratically distributed throughout the detritus than in the case of stream gravels."

There are probably many examples of typical bajada placers in the Mojave Desert and Great Basin regions of California, but recognition of them as such has not yet reached publication. Reconcentrations from former gold-bearing streams in the Mojave Desert have been described by Hulin[28] and dry placers in southern California have been listed by Sampson.[29]

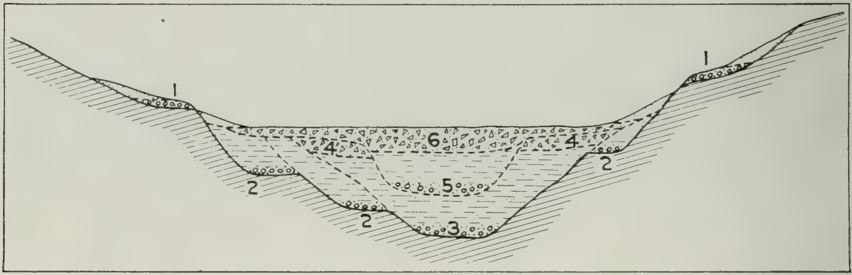

FIG. 13. Cross-section of a gold-bearing desert stream valley (Manhattan, Nevada), showing the results of several periods of stream deposition from the oldest (1) to the youngest (6). *(After Ferguson, U. S. G. S., Bull. 723.)*

Eolian Placers

Webber[30] states that: "Bajada placers usually show an appreciable and even considerable enrichment on the surface due to removal of lighter material by wind and sheet floods." This applies to some of the dry placers of California, though no commercial eolian gold deposits such as those mined in Australia, previously referred to, are known in this state.

Wind action, however, is responsible for the removal of large amounts of fine detritus in the desert. The process involved has been called *deflation* and its results described by Blackwelder.[31] It is quite likely that it will be found to play an important part in the surface concentration of desert placers.

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[28] Hulin, C. D., *op. cit.*

[29] Sampson, R. J., Placers of Southern California: State Mineralogist's Report XXVIII (Supplement), 1932, pp. 245–255.

[30] Webber, B. N., *op. cit.*, p. 15.

[31] Blackwelder, Eliot, The lowering of playas by deflation: Am. Jour. Sci., vol. 21 (5th series) 1931, pp. 140–144.

Spurr[32] described "auriferous sand dunes" in the Nevada desert seven miles south of Silver Peak, 18 miles from the California boundary line.

Beach Placers

Concentrations of heavy minerals occur in various places along the Pacific Coast as a result of the action of shore currents and waves, which tend to sort and distribute the materials broken down from the sea cliffs or washed into the sea by streams. The heavy minerals consist for the most part of magnetite, chromite, ilmenite, monazite, and zircon, with occasional fine particles of gold and platinum. Beach placers are of two kinds, (a) present beaches and (b) ancient beaches. An elevated coast line is often found overlaid with terrace gravels which were deposited at a time when the coastline was depressed. The beach placers of economic importance are those that have been reconcentrated over and over again.

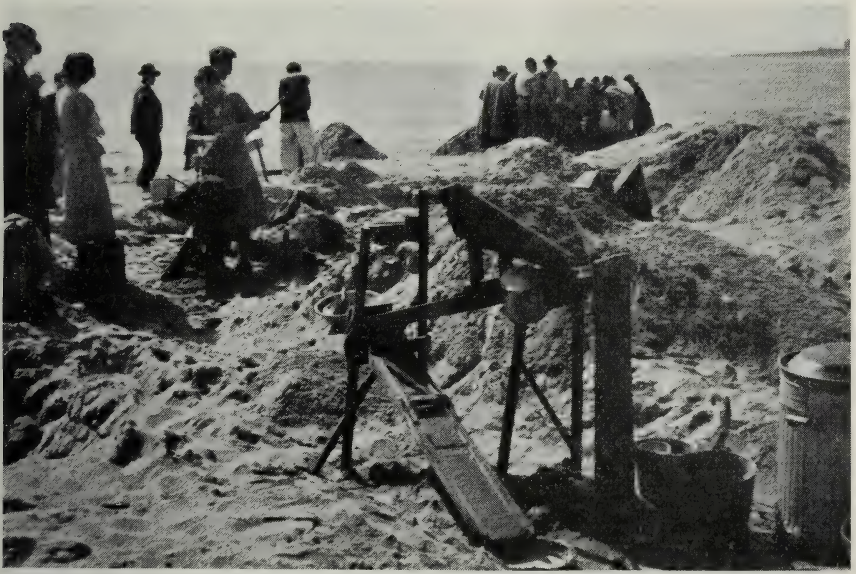

FIG. 14. 'Placer mining' in the beach sands of Santa Cruz, California (1933). *(Photo by Jenkins.)*

Excellent descriptions of the geologic processes involved may be found in reports on beach placers of Nome,[33] Alaska, and of the coast of Oregon[34] and California.[35] In discussing the origin of the gold in the Oregon beach placers, Pardee[36] says:

"Some of the miners believe that the gold of the beaches comes up out of the sea, an idea suggested by the fact that after a storm a formerly barren stretch may be found to be gold-bearing. This notion is true so far as the immediate source of some of the gold is concerned. Materials composing the foreshore are carried out in the offshore zone at one time and returned to the beach at another. In the process a shift up or down the coast may occur. * * * Soundings of the Coast and Geodetic Survey show black sand to occur in the offshore zone at the present time. Gold and other minerals are doubtless present also. * * * For the beaches that border retreating shores, however, the most of the gold and other minerals come directly from the rocks that are being eroded by the waves."

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[32] Spurr, J. E., Ore deposits of the Silver Peak quadrangle: U. S. G. S., Prof. Paper 55, 1906, pp. 96, 97.

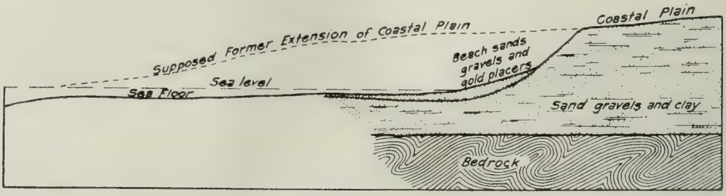
[33] Moffit, Fred H., Geology of the Nome and Grand Central quadrangles, Alaska: U. S. G. S., Bull. 533, 1913, pp. 109–123.

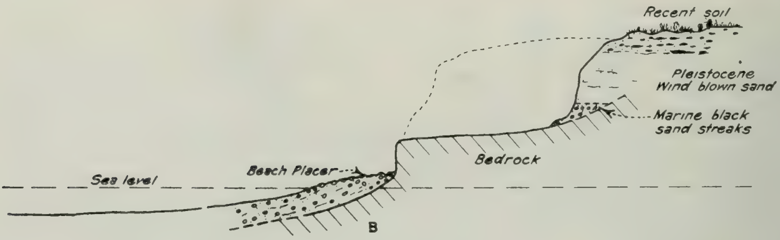
[34] Pardee, J. T., Beach placers of the Oregon Coast: U. S. G. S., Circular 8, 1934.

[35] Hornor, R. R., Notes on the black sand deposits of southern Oregon and northern California: U. S. Bur. Mines, Bull. 196, 1918.

[36] Pardee, J. T., *op. cit.,* pp. 29, 30.

The economic possibilities of mining the black sands of the California coast for their gold content have long been discussed.[37] Although gold and platinum have been the only minerals in the black sands which have been mined at a profit, much study has been given to the possible economic value of the other constituents.[38]


Supposed Former Extension of Coastal Plain
Coastal Plain
Beach sands gravels and gold placers
Sea level
Sea Floor
Sand gravels and clay
Bedrock
A


Recent soil
Pleistocene Wind blown sand
Marine black sand streaks
Bedrock
Beach Placer
Sea level
B

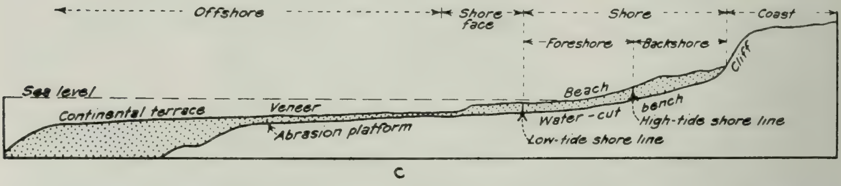

Offshore
Shore face
Shore
Coast
Foreshore
Backshore
Cliff
Sea level
Beach
Continental terrace
Veneer
Abrasion platform
Water-cut
bench
High-tide shore line
Low-tide shore line
C

FIG. 15-A. Diagrammatic cross-section illustrating the formation of beach placers in Alaska. *(Afer Collier and Hess, U. S. G. S., Bull. 328.)*

FIG. 15-B. Cross-section of a typical beach placer (Oregon). *(After Pardee, U. S. G. S., Cir. 8.)*

FIG. 15-C. Diagrammatic cross-section of a coast, showing shore zones in an advanced stage of development. *(After Johnson, see Pardee, U. S. G. S., Cir. 8, 1934.)*

Gold-bearing gravels of marine origin occur in the Chico (Upper Cretaceous) sediments of northern California. That they are marine in origin and not fluvial is shown by their content of abundant fossil sea-shells, as well as by the character of their strata. They were formerly wrongly classed as "the gravel-filled channel of a Mesozoic river."[39] Gold-bearing gravels have also been reported from marine sediments of the Lower Cretaceous of northern California.

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[37] Edman, J. A., The auriferous black sands of California: State Min. Bur., Bull. 45, 1909.

[38] Day, D. T., and Richards, R. H., Black sands of the Pacific slope: U. S. G. S., Mineral Resources, 1905, pp. 1175–1258, 1907.

[39] Dunn, R. L., Auriferous conglomerate in Calif.: Cal. State Min. Bur., 12th Rept. State Mineralogist, 1894, pp. 459–471 and map (p. 461).

Since the gravels of the Eocene rivers of the Sierra Nevada were richly gold-bearing, it is to be expected that some of the gold reached the sea. The sedimentary deposits of this Eocene sea are known as the Ione formation. They occur along the western foot of the Sierra Nevada.

Lindgren says:[40]

> "At the mouth of the rivers which descended from the Tertiary Sierra Nevada extensive delta deposits were accumulated, and it is thus difficult in many places to draw any exact line between the Ione formation and the river gravels proper. The gravels in the formation are locally auriferous, though generally poor, because spread over large areas."

The deposits contain quartz gravels and finely divided quartz grains; they are closely connected with the oldest river-channel deposits; they occur along the extreme western foot of the Sierra Nevada. Therefore, as stated by Allen,[41] the Ione sediments

> "* * * indicate delta deposits formed at the mouths of many westward-flowing streams. The presence of marine fossils in the upper part of the Ione formation shows that they accumulated on the shores of an Eocene sea."

The processes involved in the distribution and concentration of gold in the marine strata of both the Cretaceous and Eocene formations have never been carefully studied. If these marine and delta placer deposits have any particular economic significance, it certainly has not been adequately demonstrated.

PRESERVATION OF PLACERS

Placers are preserved if something keeps them from being eroded away. Since streams are continually changing their positions, fragments of their deposits are often left isolated. In cutting a deeper

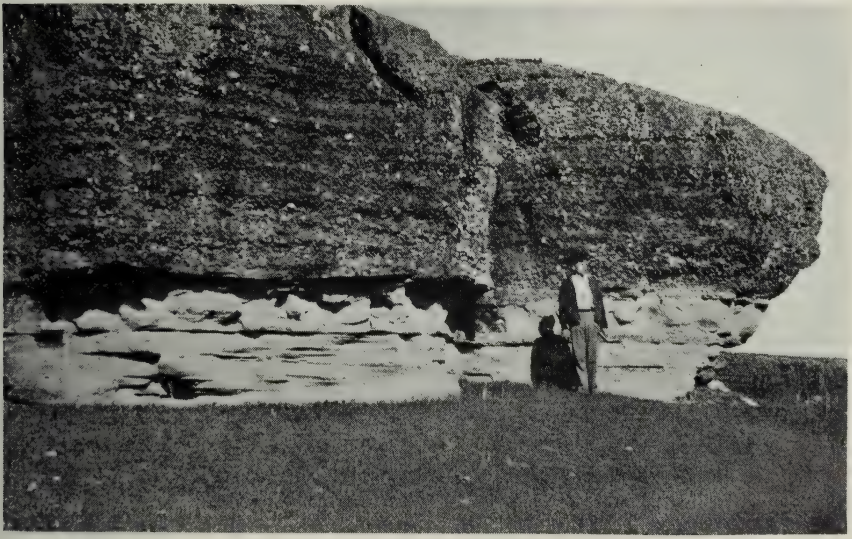

FIG. 16. Andesite 'cobble wash' and breccia overlying volcanic ash beds. Material of this sort once covered most of the foothill belt of the northern Sierra Nevada. Location: 2 miles south of Knights Ferry, Tuolumne County. *(Photo by Jenkins.)*

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[40] Lindgren, W., *op. cit.*, Tertiary gravels, p. 24.

[41] Allen, Victor T., The Ione formation of Calif.: Univ. Col., Bull. Dept. Geol. Sci., vol. 18, pp. 347–448, 1929 (p. 348).

channel, a stream leaves 'benches' or 'terraces' at different intervals along its valley sides; but erosion tends to destroy them, unless they are protected in some way.

Burial is the most effective way in which a placer may be preserved. The name 'buried channel' has often been restricted to streams covered deeply by lavas, mud-flows, ash-falls, etc., all of which were very common during the Tertiary period in the Sierra Nevada. There are, however, other means by which burial may be effected.

1. By covering with landslide material. (An example occurs in Canyon Creek, Trinity County.)

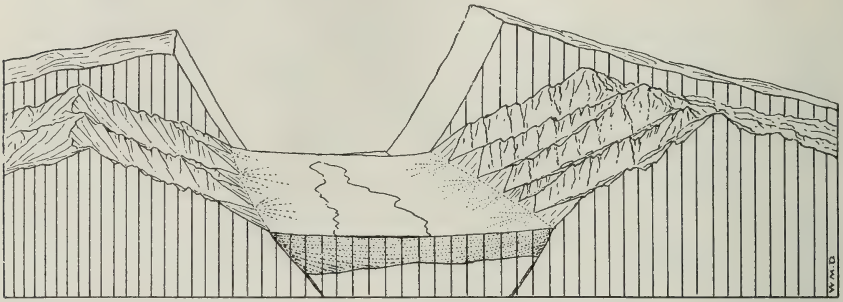

FIG. 17. Diagram showing a down-dropped fault block *(graben)* between two uplifted fault blocks. Erosion covers the one with materials derived from the others. Streams cut in bedrock prior to faulting may thus be buried under the alluvium of the graben. *(After Davis, State Min. Rep. XXIX.)*

2. By covering with gravel, caused by the faulting-down of a part of the river system. (Examples are believed to occur along the Klamath, Trinity, and some of the larger rivers of the Sierra Nevada.)

3. By covering with lake deposits. (Many of the buried Tertiary channels were covered first by lake sediments, called 'pipe-clay,' before lava or mudflows poured over them.)

4. By covering with gravels when the stream is choked. (Examples are common along stream systems.)

5. By covering with gravel when the stream course is lowered below the general base-level of erosion. (Examples of this case are found along the western foot of the Sierra Nevada.)

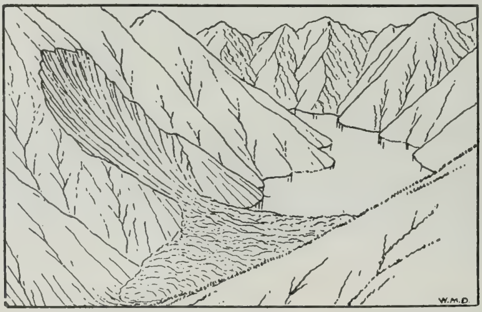

FIG. 18. Ideal sketch showing how a landslide may dam up a mountain valley to form a lake. Silt, sand, and gravels deposited in and on the edge of this lake will cover the stream gravels in its bottom. *(After Davis, State Min. Rept. XXIX.)*

6. By covering of the bedrock surface of down-faulted blocks, *graben,* by sediments of various sorts. (Many examples, especially in the Great Basin and Mojave Desert regions.)

7. By covering of older stream courses with alluvial fan material, as conditions favorable to stream existence fail. (Many examples in the Great Basin and Mojave Desert regions.)

8. By covering with glacial till. (Examples may be looked for in the glaciated areas of the Sierra Nevada.)

9. By covering of beach placers with marine sediments as the fluctuating coast is submerged, but later elevated. (Such as the present elevated beach placers which are in places covered with other marine sediments.)

10. By covering of one geologic formation with another, through the processes of earth deformation and thrust-faulting. (In a geologically active region such as California, examples of this case might very well be found.)

11. By submergence of river canyons[42] to great depth beneath the ocean. (Off the coast of California many submarine channels have been discovered and mapped by the U. S. Coast and Geodetic Survey. One extends over 75 miles from the shore and attains a depth greater than 10,000 feet. These channels are too deep, therefore, to explore for placer gold. A reported recent project to operate a sea-going gold dredge would probably have to do only with off-shore marine deposits and not submerged stream placers.)

To find gold-bearing stream channels, buried and preserved in such a manner that they may be profitably mined, is the challenge to the exploration geologist.

MODIFICATION OF PLACER DEPOSITS

Placer deposits may be greatly modified in form and structure by earth deformation. The gravel content may also become firmly cemented by interstitial deposition of mineral matter, such as by lime and iron carbonate, or silica, through the action of infiltrating solutions. The older the placer, the more apt it is to have been modified in these ways from its original form and attitude.

The regional tilt of the Sierra Nevada has increased the gradient of the Tertiary channels[43] (where they lie in the direction of the tilt) from 20 or 30 feet to the mile to twice, three times, or even several times that amount. Locally, tilting has been even greater. In places where the ancient channels lie in opposite direction to the tilt the original gradient may have been reversed. Often steep tilting is accompanied by local faulting of a few feet to several hundred feet. Generally the down-throw is on the east side of the fault plane. In form, this is a replica of the action which took place and still is taking place along the eastern escarpment of the Sierra Nevada. Such displacements and changes in channel-gradient as well as in actual position of the channel, are important factors which greatly influence mining procedure. They should be understood so far as surface data will permit, before actual mining is started in a given area.

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[42] Davidson, George, The submerged valleys of the coast of California: Cal. Acad. Sci., Proc. (3) vol. 1, No. 2, 1897.

Reed, Ralph D., Geology of California: Am. Assoc. Pet. Geol., 1933, (with references), p. 3.

Shepard, Francis P., Investigation of California submarine canyons: (Abstract) Geol. Soc. Am. Pr., 1933, pp. 107–108, 1934.

[43] Lindgren, W., *Op. cit.,* Prof. Paper 73, Plate X, "Profiles along Tertiary channels of the Sierra Nevada."

In the Mojave Desert and Great Basin region, faulting and tilting have been extremely active, greatly affecting streams antedating late Tertiary and early Quaternary periods.

The flow of ground water through stream gravels, the former channels of which have been blocked, cut off, tilted, or folded by earth movements, is a factor of considerable consequence when it comes to mining such placers.

GOLD IN PLACERS

Original Source of Gold

The particles of gold found in placers originally came from veins and other mineralized zones in bedrock, from which they were released through surface weathering and disintegration of the rock matrix. Though the original source may not in every case have been a deposit which could today be mined at a profit, the richer placers usually indicate a comparatively rich source. A long period of deep weathering, resulting in separation and release of large quantities of gold from the bedrock, followed by a more active period of erosion, generally due to uplift, is an ideal condition for gold to be swept into stream channels and there to be concentrated into rich placers. Still richer deposits may be formed through reconcentration from older gold-bearing gravels.

These are the most important geologic conditions which have been found to exist in the various gold belts of the world, and particularly in the Sierra Nevada of California.

For the most part, the original source of gold is not far from the place where it was first deposited after being carried by running water. This is certainly true in both the Sierra Nevada and Klamath Mountains. The streams, flowing through regions of metamorphic and intrusive igneous rocks threaded throughout by gold-bearing veins, were found by the early miners to contain auriferous gravels. But the more recent streams which have had only barren lavas to pass over, as in the volcanic covered area between the Sierra and Klamath regions, have proved to be barren.

Lindgren[44] states:

> "The great majority of gold placers have been derived from the weathering and disintegration of auriferous veins, lodes, shear zones, or more irregular replacement deposits. * * * In many regions the rocks contain abundant joints, seams, or small veins in which the gold has been deposited with quartz. * * * It is often stated that gold is distributed as fine particles in schists and massive rocks and that placer gold in certain districts is derived from this source. Most of these statements are not supported by evidence, though it is not denied that gold may in rare instances be distributed in this manner."

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[44] Lindgren, W., Mineral Deposits, McGraw-Hill, 1919, p. 213.

Release of Gold from Bedrock

Without some widespread process of release from the quartz veins and rocks—vaults in which the metal was originally firmly held—gold particles could not have escaped to be transported as such by running water. Therefore, extensive rock weathering and decay over a long period of time is a primary factor of extreme importance. It has permitted the original source to contribute gold particles, large and small, to placer accumulations. The same geologic processes which form residual and eluvial or 'hillside' concentrations of commercial merit operate in the general release of gold from bedrock.

The factors of prime importance in weathering are *solution,* changes of *temperature,* depth of *water-table* and therefore depth of *oxidation,* action of *rain,* effect of *gravity,* growth of *vegetation,* nature and *composition of material* acted upon, and degree of *topographic relief.* Rock weathering, especially *complete* disintegration down to the water-table, rather than *deep* disintegration, is often more favored by tropical climates. This, however, is only one factor, and large areas of deep secular weathering are found in the north, in such places as Alaska, where placers are abundant.

The processes which take place in the separation of gold from bedrock are described in detail by Brooks,[45] who says:

> "The breaking down of the rock and the accompanying chemical changes of the constituent materials set free the gold, one of the relatively indestructible minerals, and this becomes intermingled with the other insoluble material. Clay dominates in the residual mass, but if the parent rock contained quartz, this, too, usually remains, being probably the most refractory of all the common minerals toward purely chemical agencies. Mineralized vein quartz very commonly carries easily decomposed minerals, such as pyrites, and is therefore readily broken up, allowing the insoluble ingredients of the ore body, such as gold, to be set free. This process is hastened by purely physical agencies, such as frost and changes of temperature, which break up the insoluble rock constituents. * * *
>
> "As a rule, the changes in a rock mass brought about by weathering result in a very material reduction in its bulk.[b] The loss of material by weathering among siliceous crystalline rocks, according to Merrill,[c] amounts to more than 50 per cent, and in the purer forms of limestone it may reach as high as 99 per cent. Pumpelly[d] has estimated that in the limestone areas of the Ozark Mountains the residual material represents only from 2 to 9 per cent of the original rock mass. Such reductions in volume necessarily result in more or less concentration of any insoluble material that may have been disseminated in the parent rock. This concentration will be materially greater in the case of substances of high specific gravity, such as gold, than in that of the lighter minerals, for the former will have a constant tendency to settle to the bottom of the loose material. On declevities gravity will accelerate the process and help to sort the material, producing in some places a rough stratification.[e] This is a secular process and will proceed as long as the rocks continue to disintegrate. * * *
>
> "It is evident that the effectiveness of all these agencies is proportional to the length of time in which they are operative. A land mass must remain stable relative to sea level, for a long period of time to permit the accumulation of any considerable amount of residual material. Uplifts bring about renewed activities of the watercourses, and the residual mantle is quickly removed by erosion. It is evident that the conditions that are most favorable to the accumulation of residual material are those in which the land mass is at or near base-level when erosion is reduced to a minimum."

It seems that topographic and climatic conditions which existed during the Eocene period in the Sierra Nevada were very favorable for the release of gold. Rejuvenated drainage at the close of the period swept the immense quantities of gold, freed from the enclosing hard matrix, into the early Tertiary stream channels; and these, soon after, became buried and preserved by lake sediments, masses of gravel, cobble-wash, volcanic ash, breccia, and lava flows.

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[45] Brooks, Alfred H., The gold placers of parts of Seward Peninsula, Alaska: U. S. G. S., Bull. 328, 1908, pp. 125–127.

[b] Merrill has shown that in certain changes by hydration there is an increase in bulk. He estimated that in the conversion of granite into soil (District of Columbia) there had been an increase in volume amounting to 88 per cent. Compare Merrill, G. P., Principles of rock weathering: Jour. Geol., vol. 4, 1896, p. 718.

[c] Merrill, G. P., Rocks, rock weathering, and soils, New York, 1897, p. 234.

[d] Pumpelly, Raphael, The relation of secular rock disintegration to loess, glacial drift, and rock basins: Am. Jour. Sci., 3d ser., vol. 17, 1879, p. 136.

[e] Kerr, W. C., The gold gravels of North Carolina, their structure and origin: Trans. Am. Inst. Min. Eng., vol. 8, 1879–80, pp. 461–462.

Associated Minerals

Mineral grains that are very heavy and resistant to mechanical and chemical destruction accompany the gold in placers. The so-called 'black sands,' generally made up principally of magnetite, are well-known to the miner. A long list of the minerals found in sluice-box concentrates is recorded by the United States Bureau of Mines.[46] Besides magnetite, there are found titanium minerals (ilmenite and rutile), garnet, zircon, hematite, chromite, olivine, epidote, pyrite, monazite, limonite, platinum, osmiridium, cinnabar, tungsten minerals (wolframite and sheelite), cassiterite, corumdum, diamonds, galena, as well as quicksilver, amalgam, metallic copper, bird-shot, bullets, hob-nails, penknives, watches, and nails.

Buried deeply in the gravels of the modern Feather River was once found (and someone thought it was an ancient fossil) the remains of a mule's hind leg with hoof and iron shoe nailed to it. What may be found in some of the placers of today may not, therefore, be representative of what was deposited by the more ancient streams.

The presence of quantities of magnetite associated with extremely fine gold particles, makes a difficult metallurgical problem. To the

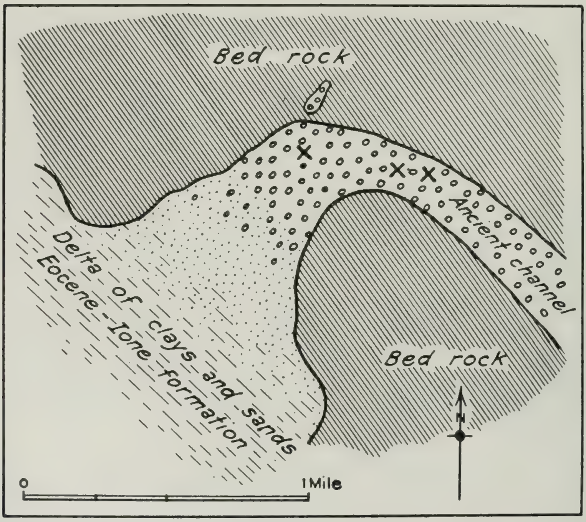

FIG. 19. Sketch map of an early Tertiary channel and its delta in the Eocene (Ione) sea. The crosses indicate where the gold has been mined in the channel—on a bend in the stream, and at the point where a tributary entered. Finely-divided gold particles occur interbedded in lenses of quartz pebbles and sand lying above clay layers ('false bedrock').

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[46] Gardner, E. D., and Johnson, C. H., Placer mining in the Western United States. Part I.—General Information: U. S. Bureau of Mines, I. C. 6786, Sept. 1934, pp. 15–20.

geophysicist, however, the presence of any minerals having a strong effect on the magnetometer is a godsend to effective exploration.

The determination of heavy minerals and their approximate relative percentage has been extensively used in subsurface correlation[47] of sedimentary beds in the oil fields, and tables have been developed for use in determining these minerals.[48] The same method of research could well be applied to the tracing of channels. Though it has not yet been given consideration in California, this interesting field is open for study, with a well-developed technique[49] available.

The source of the minerals deposited and associated with the gold particles lies in the rocks over which the stream has flowed. The source of chromite, platinum, and diamonds is generally attributed to belts of serpentine and related ultra-basic igneous rocks, while garnet, ilmenite and magnetite might come from metamorphic rocks, and monazite, zircon, cassiterite, wolframite, and scheelite would probably have their source in granite pegmatites.

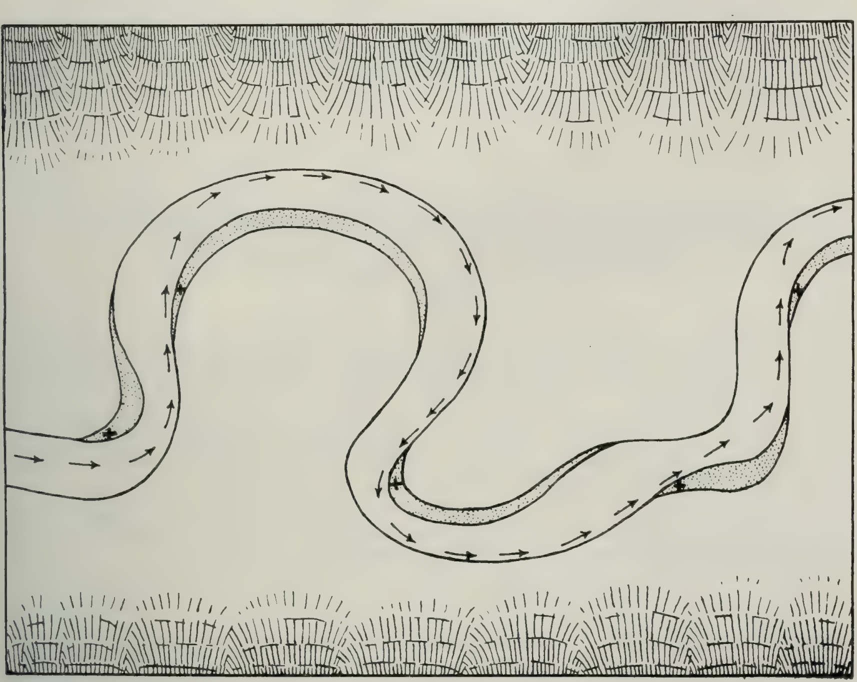

FIG. 20. Diagram to illustrate the course of a river, indicating where gold particles are most likely to become concentrated. *(After Spurr, U. S. G. S., 18th An. Rept. 1898.)*

Transportation, Deposition, and Retention

The processes of transportation and deposition of gold in a stream are aptly stated by Brooks:[50]

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[47] Tickell, F. G., The correlative value of the heavy minerals: Am. Assoc. Pet. Geol., Bull. 8, pp. 158–168, 1924.

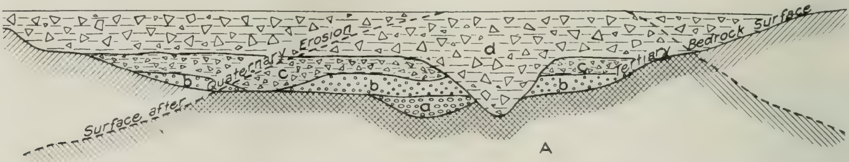
[48] Tickell, F. G., The examination of fragmental rocks: Stanford University Press, 1931.

[49] Raeburn, C., and Milner, Henry B., Alluvial prospecting, the technical investigation of economic alluvial minerals: D. Van Nostrand Co., 1927.

[50] Brooks, Alfred H., *op. cit.*, p. 128.

"The transporting power of a stream is dependent on its velocity, which is a variant determined by the gradient, volume, and load. When a stream is overloaded with sediment, the excess is dropped. When it is underloaded, it erodes. When equilibrium has been established, neither erosion nor deposition takes place. Gradient, volume, and load usually vary in the same stream so that deposition may be going on in one part of its valley and erosion in another. When a stream is eroding, the material within reach of its activity is constantly moved in a downstream direction. All movements of this kind are accomplished by more or less sorting and make for the concentration of the heavier particles.

"Deposition takes place in a stream when the velocity is decreased, either by the periodic changes in volume or by a change of gradient. Where there is a change of grade, resulting in diminished velocity, the gold is laid down with the other sediments. It must be remembered, however, that placer gold may find lodgment in inequalities of the bedrock surface where no considerable deposition of detrital matter has taken place, though extensive placers are, as a rule, not formed because of irregularities in the bed-rock surface alone. The concentration of gold in river bars is analogous to its deposition in stream beds, for it is dropped where the velocity of the current is checked by the formation of eddies, due to the inequalities of the river floor."



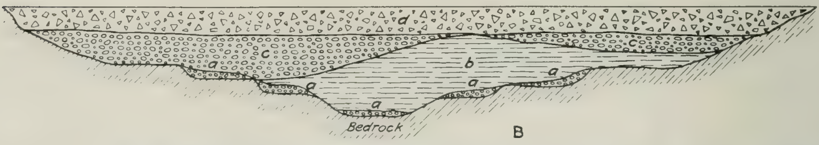


FIG. 21-A. Diagrammatic cross-section showing the four principal epochs of Tertiary gravel deposition in the Sierra Nevada. The deep gravels *a* represent Eocene; *b* to *d* are successively younger and probably represent Miocene stages for the most part. The rhyolite period is represented by *c* and the andesite by *d*.

FIG. 21-B. Diagram showing deposits in the Deep Blue lead, Placerville. The older channel and benches of the inter-rhyolitic epoch are represented by *a*; rhyolite tuff, *b*; andesite cobble, *c*; andesite tuff-breccia, *d*. *(After Lindgren, U. S. G. S., P. P. 73.)*

A further study of this subject is made herein in connection with the more detailed analysis of stream action.

When the bed of a stream is the actual rock floor of the valley, it is called 'bedrock' in the true sense of the word. Later in its history the stream may flow on an aggraded bed of gravel or other sediment. If the stream gravels become covered with volcanic or other materials, the stream is obliged to flow over this new cover, called 'false-bedrock.' Gold particles are normally deposited on or near the bed of the stream, which is called 'bedrock' or 'false-bedrock' according to whether the bed is the true hard rock floor of the valley or whether it is a superficial layer of clay, volcanic tuff, or some such impervious material overlying previously deposited gravel. It is readily surmised, therefore, that there may be two or more tiers of gold-bearing stream channels, but the upper ones do not necessarily lie directly above the older and lower channels, and may not follow the direction of their courses at all. If the stream cuts clear down to the true bedrock, remnants of the older channels will lie at relatively higher positions instead of at lower horizons. In some cases, where gravel is deposited deeply on bedrock, forming a new aggraded bed, rejuvenation of the stream will stir up the entire mass of gravels, including the gold-bearing layer deposited on top, and the final result will be that most of the gold particles will reach a position very near true bedrock. The complexity of the history of these processes is apparent; so also are the difficulties of the engineer who attempts to do a fair job of sampling.

In excavating for the Boulder Dam a sawed plank of lumber was found 60 feet deep, ''lying under gravel on the edge of the inner gorge, a place that it could not have reached in any imaginable way except by burial during some comparatively recent flood.'' * This case and many others show that the depth of burial by recent rivers does not necessarily mean that a great period of time has elapsed for the accumulation of the deposit. During high water, the whole mass may be stirred up and even boulders floated in the soupy mixture of heavy rock debris and water. This action gives the gold particles a chance to work their way toward the bottom of the mass.

For thousands of years particles of gold of various sizes, from nuggets to flour gold, were dropped and lodged in the riffles of bedrock along the natural river-sluices of the Sierra Nevada. Flattened particles are most easily carried; sometimes, suspended by air-films, tiny scales even float on the surface of the water.[51] Extremely fine grains of gold were swept by torrents through the canyons and out into the Great Valley. In the present dredging grounds where they are found, they have been easily caught in false-bedrock, which consists of clayey layers of volcanic tuff.

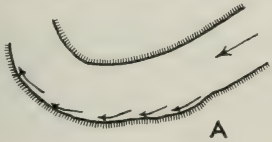


FIG. 22-A. Diagram showing the place of greatest erosion on the bend of a river.

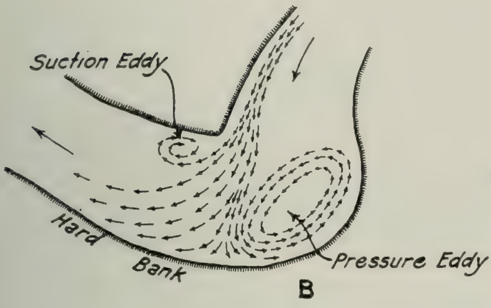


FIG. 22-B. Diagram to show positions of pressure and suction eddies in a river. Gold is more likely to be deposited in the suction eddy than in the pressure eddy.

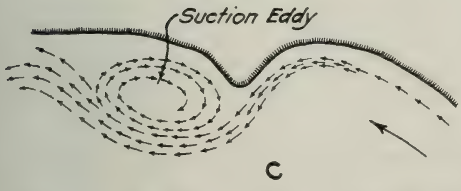


FIG. 22-C. Diagram to show how a suction eddy is formed in a river. *(After Thomas & Watt, see Ries and Watson, Eng. Geol.)*

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* Berkey, Charles P., Gorge excavation confirms geological assumptions. Eng. News-Record, vol. 111, 1933, p. 762, Fig. 2.

[51] Lindgren, W., Mineral Deposits, 1919, p. 220.

The very high specific gravity of gold, six or seven times that of quartz, with the ratio increasing to nine times under water, is the primary factor which causes this heavy resistant metal eventually to work its way to a point where it may sink no farther. Once it is caught on bedrock, the stream has great difficulty in picking it up again.

When a stream leaves its mountain canyon and enters a more level country or a still body of water, the materials carried by that stream are deposited in the form of a fan or delta. At the apex of this fan or delta fine gold may be deposited, and may never reach bedrock. It may be deposited on top of clayey, 'false bedrock' layers. The stirring action found to occur in rugged mountainous canyons during times of floods, which permits gold to reach bedrock, does not take place in the delta.

Lindgren states:[52]

> "By an odd paradox, gold is at the same time the easiest and most difficult mineral to recover. It is divisible to a high degree and owing to its insolubility the finest particles are preserved. A piece of gold worth one cent is without trouble divisible into 2000 parts, and one of these minute particles can readily be recognized in a pan."

Although gold is very malleable, and may be hammered into different shapes by stones hitting it as they tumble along in the stream, different particles are not welded together to form larger nuggets, as some people are prone to believe. Lindgren[53] has shown that the largest masses of gold have come from lodes, not placers. Particles of gold may be broken down, however, from another piece. The more rounded or flattened nuggets have probably gone through more knocking about than the rougher pieces. Those showing the original crystalline forms have probably not traveled far in the 'free' state.

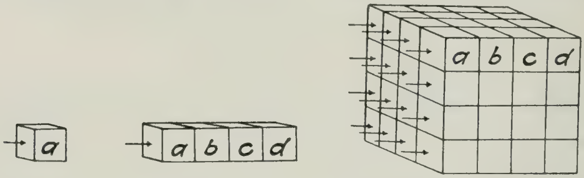

FIG. 23. Diagram to represent the theoretical effect of increased velocity (V) on transporting power (T) of a stream. $T \propto V^6$, i.e., if the velocity is doubled, the transporting power increases as much as 64 times.[1] *(After Chamberlain & Salisbury.)*

[1] Gilbert, G. K., The transportation of debris by running water: U. S. Geol. Survey, Prof. Paper, 86, 1914, pp. 15–16.

("A statement more frequently encountered is to the effect that the quantity varies with the sixth power of the velocity; and the origin of this assertion is now in doubt. It is an erroneous version of a deductive law. * * * The law, as formulated by Hopkins, is that 'the moving force of a current, estimated by the volume or weight of the masses of any proposed form which it is capable of moving, varies as the sixth power of the velocity'; and this law pertains not at all to the quantity of material moved, but to the maximum size of the grain or pebble or boulder a given current is competent to move.")

It is also found that the more ancient placers, and those which have undergone many reconcentrations, contain gold of a higher degree of fineness than those whose source is near by, or in which the gold has not been deposited for such a long period of time. This may be due to the removal of alloyed silver by the dissolving action of surface waters.[54]

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[52] Lindgren, W., *op. cit.*, p. 220.
[53] Lindgren, W., Tertiary Gravels, *op. cit.*, p. 66.

The solution and reprecipitation of gold in the gravels is shown to be exceedingly rare or nonexistent, commercially.[55] On the other hand, in some of the Tertiary channels, thin crusts of pyrite or marcasite are found deposited on the surface of the gold particles themselves.

Factors of Concentration

A placer worthy of mining is like any other commercial mineral deposit in that it is a special case of concentration due to several combining natural processes which were all in favor of the accumulation of the one desired mineral. Source, release, transportation, deposition, reconcentration, and retention of the gold have already been discussed. Three extremely important factors are: (1) Structural control of the stream pattern, so that the streams run along the course of the zones of mineralization; (2) Decay and disintegration at the surface of the mineralized rocks prior to erosion; (3) A change in the cycle of erosion, causing rejuvenated flow of streams and the rapid washing of the released gold into stream channels.

Quoting from a recent paper appearing in the Engineering and Mining Journal:[56]

> "Accumulation of gold in an important placer deposit is rarely a mere coincidence; it is rather the fortuitous concurrence of several favorable factors. In regions where nature has bestowed the advantages of extensive mineralization, rapid rock decay, and well-developed stream patterns, a relatively large amount of gold placer may be formed. But even in this ideal case, the favorableness of these several important factors must be assumed.
>
> "The general considerations which favor the accumulation of gold in special locations have been frequently discussed. Physically, the phenomenon is simple; in such locations where the gold has been deposited, the transporting power of the stream has become insufficient to carry away the particles of gold that have settled. The richness of the deposit will therefore depend not only upon the completeness of this loss of transporting power, and on the ability of the bedrock to hold the deposited gold at this point, but also, most importantly, on the general relationship of the gold sources to the stream. The early miners untiringly sought the 'ledge' or 'mother lode' which furnished certain rich placers. However, with the presence of mineralized zones as a source of the gold, the richness of a placer is perhaps due more to the efficiency of the stream as a concentrating device than to its uncovering rich lode deposits.
>
> "The ability of a stream to transport materials is essentially dependent upon the velocity of the water and the area and specific gravity of the particles of material being carried. The transporting power of water varies approximately as the sixth power of the velocity. This means that even small velocity changes have an enormous effect upon transporting power, ranging rather abruptly from velocities which can not transport an appreciable amount of gold to those which easily transport much of the gold that may enter the stream or be released from the gravels therein. The velocity of water is a complex relationship of grade, shape, and size of the channel, quantity of water, and other factors. A grade ranging from 30 to approximately 100 ft, per mile will favor the deposition of gold. With appropriate conditions of flow, these limits may be somewhat increased or reduced without serious handicap. When considering the grades of the ancient channels, however, one must remember that faulting and regional tilt often have considerably modified the original grade.
>
> "For the richest accumulations, the erosional conditions must be well balanced, so as to provide a long period of concentration. Slight uplifts tend to rework and further enrich placer deposits, as do increased volumes of water, inasmuch as both of these factors tend to increase the velocity. Local variations in the shape of the channel are of most interest, however, because they are immediately responsible for specific deposits of placer gold. When a stream canyon widens out, deepens, turns, or joins another watercourse, certain zones of concentration will be formed where the water velocities have been somewhat reduced and where eddy currents occur. These reductions in velocity immediately allow gold and heavy mineral particles to separate from the mass of gravel that is being carried and rolled down the canyon.

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[54] Lindgren, W., Tertiary Gravels, *op. cit.*, p. 68.

[55] Lindgren, W., Tertiary Gravels, *op. cit.*, p. 69.

[56] Jenkins, Olaf P., and Wright, W. Quinby, California's gold-bearing Tertiary channels: Eng. & Min. Jour., vol. 135, Nov., 1934, p. 501, 502.

Gold has a specific gravity of approximately six times that of the gravel, but under water this ratio becomes about nine times. This large gravity difference permits the gold quickly to work its way to bedrock and into any crevices therein. Here it remains, requiring excessive erosion to remove it to new locations.

"In order that a major deposition of gold may occur, there must be an abundance of source material which contains more or less gold and which may be more or less easily eroded. A decayed formation of low-grade material could easily furnish more gold than a hard, higher-grade deposit. The decomposed material also supplies more gravel for balanced conditions of stream transportation, providing that overloading or choking is minimized by uplifts or increasing water volumes. Plainly, a stream running along a vein system will have a greater opportunity to accumulate gold than one merely crossing it. Bedrock-controlled streams, therefore, provide a maximum contact with source material.

"A further and very important factor is the ability of bedrock to hold the deposited gold in spite of the scouring action of the stream at higher water stages. A smooth, hard bedrock is a very poor one for placer accumulations. Bedrock formations which are decomposed or possess cracks and crevices are good, and those of a clayey or of a schistose nature are excellent in their ability to retain particles of gold.

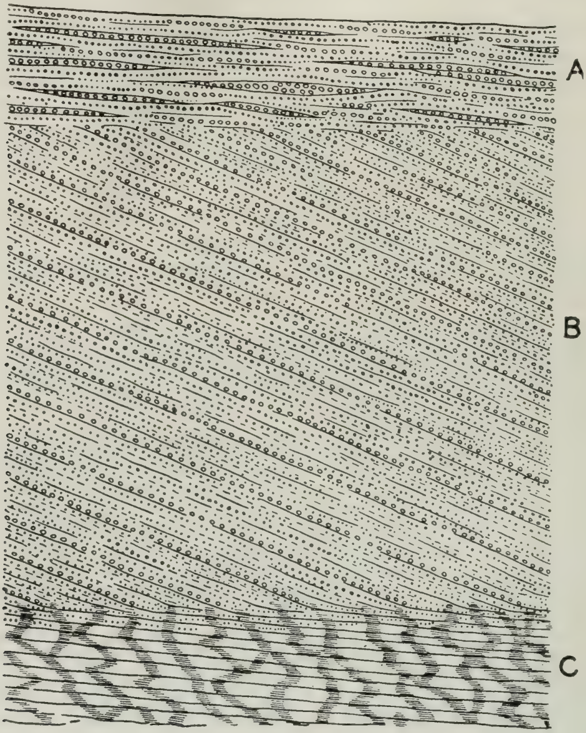

FIG. 24. Ideal vertical section of a delta, showing in greater detail than Fig. 24, the typical succession of strata: (A) topset, (B) foreset, and (C) bottomset beds. *(After Gilbert, U. S. G. S., 5th An. Rept., 1883.)*

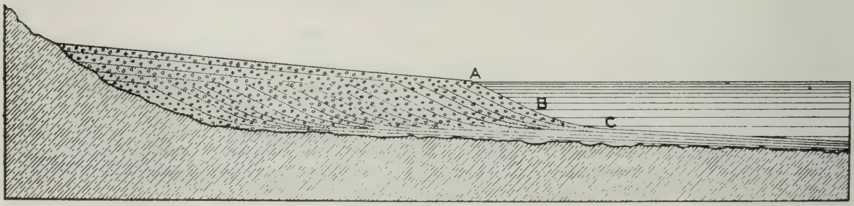

FIG. 25. Ideal cross-section, of a delta, showing (A) topset, (B) foreset, and (C) bottomset, beds. *(After Gilbert, U. S. G. S., 5th An. Rept., 1883.)*

> "Gold tends to resist most stream transportation. Coarser gold will migrate downstream an amazingly short distance from its apparent source throughout a long erosion period. The fine gold, which the stream can transport, is dropped rather completely within a restricted area at the mouth of the stream canyon."

AGE OF PLACERS

Significance

The geologic age of a placer deposit is often a factor of primary economic interest. In the Sierra Nevada, the oldest system of Tertiary channels has proved to be the richest, for it was formed prior to the extensive volcanic activity which resulted in the covering of the mineralized bedrock surfaces as well as the valleys in which gold-bearing streams flowed. These streams, which cut directly through the mineralized zones, had an ideal opportunity to tap the primary gold resources of the region, while those which flowed only over a barren volcanic cover remained themselves barren of gold. In the region of the buried channels of the Sierra Nevada, many stream deposits of different periods are now found intermingled. To decipher their history and relative age is an essential part of the exploration geologist's work, in his search for the channels of greatest possible economic consequence.

Structural Criteria

Various criteria are used in determining the relative age of stream deposits, but the most positive evidence is structural relationship. For example, the cutting channel is younger than the channel which it cuts.

The deepest channel is not necessarily the oldest nor yet the youngest. In the case of the modern canyons of the Sierra—the youngest are the deepest; yet along the western foot of the range the present streams flow over older channels buried beneath. Where a canyon is filled with detritus or with lava, the newer stream flows on top of the deposit and is therefore higher than the old stream-bed beneath, while still more ancient stream terraces or benches may lie at higher and varying elevations on either side of the canyon. Some benches, representing former streams, may have even been left prior to a lava flow covering the deepest channel, while other benches may have been left later.

It is apparent, therefore, that the subjects of historical sequence and relative age are matters of detailed geologic and physiographic study which deserve more than mere superficial examination. They cannot be classified by dogmatic rules.

Paleontologic Criteria

In order to assign definite geologic periods to the deposits of ancient streams, their age should be related in some way to the well-established epochs of regional geologic history. Fossils, diagnostic in determination of geologic periods, if found in the stream deposits, are of inestimable value in this regard.

In the Sierra Nevada, parts of fossil plants consisting of leaves, logs, etc., have been extensively collected and determined by paleobotanists. Also, some vertebrate bones have been sent from the old drift mines to the Smithsonian Institution and elsewhere for scientific study.

Geologic periods the world over have been established largely on their marine fauna rather than their continental flora or fauna. For instance, marine beds of the Ione formation contain fossil sea-shells definitely assigned by paleontologists to the Eocene, or earliest Tertiary period. The fossils found in the sediments filling the Tertiary valleys of the Sierra are not, however, marine, but are of ancient lands and lakes. Correlation of geologic age by means of these land plants and land animals brings in complications that have not yet permitted the two bases of criteria, marine and nonmarine, to be perfectly coordinated. Besides, most of the fossil leaves occur in tuffaceous lake beds that overlie the gold-bearing quartz-gravel deposits, and therefore do not give much direct evidence as to the age of the latter. Fossil wood, so common in the most ancient of the gold-bearing gravels is not as yet determinable nor diagnostic. In most cases it represents unstudied tropical forms which have been placed in the Eocene by paleobotanists because of the known climate of that period. The older gravel containing this fossil wood has previously been referred to the Cretaceous. In the Smartsville quadrangle, for example, a deposit containing petrified logs of probable Eocene age is described by Lindgren as follows:[57]

> "The high, isolated area of well-washed gravel 3 miles north-northwest of Montezuma Hill is noteworthy; it is so much higher than the adjacent gravel channel of North San Juan that it must be assumed to belong to an earlier period; very likely it is of Cretaceous age."

It is a fact, however, that no fossils indicating a Cretaceous age have yet been found in these older gravels. Wherever definite marine Cretaceous beds do occur on the western foot of the Sierra Nevada the oldest stream channels of the vicinity are found to cut the Mesozoic sediments, showing a profound difference in age between the two.

Chaney[58] summarizes the results of paleobotanical study of the fossil plants found in the Sierra Nevada as follows:

> "The tuffs and shales in which fossil plants occur interbedded in the Auriferous Gravels range in age from lowermost Eocene to upper Miocene. During this time, there was a climatic trend from subtropical to temperate conditions, which resulted in the elimination of palms and other large-leafed species and the incoming of types of plants similar, in general, to those now living in North America. The Miocene flora indicating a temperate climate, includes genera no longer living in western America, although they occur in eastern America and eastern Asia. The evidences of difference in living conditions in the Eocene and the Miocene make it possible readily to differentiate between the older and the younger floras of the Auriferous Gravels."

Most of the fossil vertebrate bones described from the drift mines of the Sierra Nevada have been collected and sent in to paleontologists by persons who did not record their definite location, so that the exact geologic formations in which the fossils were embedded are unknown.

The paleontologist who works with vertebrate remains is not always apt to apply the same age to beds as that which has been assigned them by the paleobotanist; generally the former assigns a younger age. Many of the well-established Sierran Tertiary as well as later beds containing vertebrate bones were once given the blanket designation of Pleistocene.[59]

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[57] Lindgren, W., Tertiary Gravels, *op. cit.*, p. 124.

[58] Chaney, Ralph W., Notes on occurrence and age of fossil plants found in the auriferous gravels of Sierra Nevada: State Mineralogist's Rept. XXVIII, 1932, p. 301.

Physiographic Criteria

Age correlation has sometimes been done purely on physiographic evidence. Matthes[60] assigns Eocene, Miocene, Pliocene, and Quaternary periods of uplifts to the various old surfaces found in the Yosemite region, tying in the Miocene surface correlation with geologic features of a fossil leaf locality occurring in the Tuolumne Table Mountain region. The fact that old surfaces have been resurrected[61] during the Pleistocene has only recently been given consideration.

> "Quaternary erosion resulting in the uncovering of Tertiary volcanic ash and the resurrection of early Tertiary surfaces, formerly cut into pre-Cretaceous bedrock along the western flank of the Sierra Nevada, is a widespread geologic process which has heretofore not received the recognition it deserves. The process involves features of vast economic concern. One key locality for this study is in the region of Table Mountain, Tuolumne and Calaveras counties, California, where a very resistant late Tertiary latite flow has served the purpose of preserving not only fragments of earlier and less resistant geologic bodies consisting of volcanic materials, mud-flows, lake beds, and stream gravels of different ages, but also the underlying bedrock surfaces of earlier Tertiary age. These ancient surfaces, the topography of which appears to have been controlled by bedrock structure, may be found in various stages of resurrection. In this area, the gold-bearing gravels were mined in ancient channels that ran in directions opposite or at an angle to the Table Mountain Channel; the latter apparently never contained any appreciable amount of gold-bearing gravel, contrary to the common belief. Though unmantled and dissected through Pleistocene and Recent epochs, fragments of upland peneplained bedrock and in places gravel-covered surfaces are actually early Tertiary land forms, which have been brought to light after having been buried throughout later Tertiary volcanic epochs."

Lithologic Criteria

The nature and composition of the material filling the ancient channels and valleys also indicate to what geologic period a deposit may belong. Gold-bearing gravels, composed purely of sand and quartz-pebbles, or of the bedrock complex, indicate that the channel is of the pre-volcanic period, possibly Eocene in age. Most of the rhyolites were apparently formed during the latter part of this period and in the Oligocene. The most abundant of the volcanic rocks are composed of andesites, which seem to be largely of late Miocene or early Pliocene age. During the late Pliocene and early Pleistocene there were many basalt flows. Tuolumne Table Mountain is composed of latite, probably of late Pliocene age.

In the Recent period much pumice has been expelled from craters and blown over various parts of the Sierra Nevada.

Streams may always be considered younger than the rocks from which their gravel has been derived, though mudflows may receive their materials from active volcanoes. There is here an opportunity for a petrographic study of both volcanic rocks and the materials of the sediments. Special detailed analysis of stream correlation might be performed by means of the method known as "heavy mineral separation," previously mentioned as widely employed in petroleum geology.

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[59] Hay, Oliver P., The Pleistocene of the western region of North America and its vertebrate animals: Carnegie Inst., Wash., Publ. No. 322 B, 1927.

[60] Matthes, Francois E., Geologic history of the Yosemite Valley: U. S. Geol. Survey, Prof. Paper 160, 1930.

[61] Jenkins, Olaf P., Resurrection of early surfaces in the Sierra Nevada: State Mineralogist's Rept. XXX, 1934, p. 5.

Coordination of Criteria

In order to assign a geologic age to a placer, all criteria should be sought out and used so far as it is possible. A regional study of age relationship should include a coordinated study of all phases: structure, fossils, surface features, and materials deposited.

The principal placers in California occur in the Quaternary, Tertiary, and Cretaceous geologic time divisions, which are grouped in the following manner:

ERA	PERIOD	EPOCH		DURATION in millions of years
Cenozoic	Quaternary	Recent		
		Pleistocene		1
	Tertiary	(Neocene or Neogene)	Pliocene	7
			Miocene	12
		(Eogene)	Oligocene	16
			Eocene	23
Mesozoic	Cretaceous			75
	Jurassic			40
	Triassic			40
Paleozoic				415
Proterozoic				Unknown

LIFE HISTORY AND HABIT OF STREAMS

Need for Scientific Background

Exploration of placers and various ancient stream channels requires an understanding of the habits and life history of streams in general. This includes, on the one hand, processes of erosion and deposition, and on the other, physiographic history. Each is important; the first, more directly, while the second has to do with regional features, knowledge of which is essential to the exploration geologist. The fundamental science of streams has been outlined in a simple yet splendid manner by G. K. Gilbert[62] in his masterpiece on the Henry Mountains, Utah. Later, I. C. Russell published an excellent text on streams.[63]

Such natural processes as those related to streams are so universal that a study of them in one part of the world may be applied to conditions found in another. Similarly, an understanding of the ancient Tertiary streams of the Sierra may be gained by applying the knowledge of processes found in operation today where conditions and environments would appear similar.

In a province, such as the Sierra Nevada, where the development of the drainage system has been repeatedly interrupted by earth movements or by burial as a result of volcanic mud washes and lava flows, the history of the stream of any one chronological horizon is a separate entity, and may be entirely different in form and pattern from either earlier or subsequent systems. This fact, together with the complexity of any one system presents a problem much involved.

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[62] Gilbert, G. K., Report on the geology of the Henry Mountains; U. S. Geog. and Geol. Survey of the Rocky Mountain Region, 1877, Chapter V, Land Sculpture, pp. 99–150.

[63] Russell, Israel C., Rivers of North America, a reading lesson for students of geography and geology: G. P. Putnam's Sons, 1898.

The need for a scientific background in the study of streams is therefore apparent. The more pertinent features of this study, together with its terminology, are outlined in the following pages.

Stream Erosion

Stream or *fluvial* erosion is complex. It may be divided into the several processes, *hydraulic action, abrasion, solution,* and *transportation.* A brief statement of the essential factors which control erosion is quoted from an authoritative textbook[64] as follows:

> "The capacity of a stream to erode depends on its volume and velocity. The velocity in turn depends on (1) the slope down which the stream is flowing, (2) volume of water, (3) the shape of its channel, and (4) weight and volume of its load.
>
> "The rate of descent of the bed of a stream is the *stream gradient.* It is ordinarily expressed as so many feet per mile. The gradient changes from place to place along the course of the stream. Velocity increases rapidly with increase of gradient. Thus mountain streams with high gradients erode their valleys much more quickly than lowland streams of comparable size with low gradients. It follows that streams wear high gradients down to low ones by continued erosion, and that as the gradients are worn down the rate of erosion must decrease.
>
> "The volume of water is a variable factor in all streams, largely because of fluctuations in rainfall. Velocity and rate of erosion in any stream are therefore always changing. As a rule, these changes are too slight to be readily noticeable, but in some regions they are great enough to cause streams to dry up at certain seasons, and to rise in floods at others. In other regions fluctuations are less extreme. Every spring the lower Mississippi has a normal rise in water level of 15 to 20 feet. The Nile normally rises 24 feet and the Ganges 32 feet. The erosive effect of such floods is considered below.
>
> "The shape of the stream channel as seen in cross-section also influences velocity. Since friction between water and channel slows a stream down, velocity is greatest in channels with the smallest area in proportion to volume of water. Deep, narrow channels therefore give greater stream velocity than broad, shallow ones.
>
> "A stream continues to acquire a load until it is carrying the greatest possible amount permitted by the gradient, volume of water, and kind of material available."

The "laws of erosive power" concern both transportation and abrasive power of the stream. If all the fragments of rocks had the same specific gravity, then the following definite action would take place.

> "If the velocity of a stream be doubled, the diameters of rock fragments it can move are increased 4 times. In other words, *the maximum diameter of the individual rock fragments a stream can move varies as the square of the velocity.* * * * Calculations have shown that doubling the velocity of a stream increases its abrasive power at least 4 times, and under certain conditions as much as 64 times. In other words, *abrasive power varies between the square and the sixth power of the velocity.*
>
> "These laws not only explain the vastly greater erosion accomplished by swift streams than by slow ones under normal conditions, but they show clearly why exceptional floods, greatly increasing velocity by increasing volume, have such tremendous destructive power. The volume of the Colorado River measured at Yuma, Arizona, during a flood in 1921, was 155 times its normal volume. Again, when the St. Francis dam near Los Angeles gave way in 1928 and flooded the valley below, huge blocks of concrete weighing up to 10,000 tons each, were moved by the escaping water. In India, during the Gohna flood of 1895, which lasted just four hours, the water picked up and transported such quantities of gravel that through the first 13 miles of its course the stream made a continuous gravel deposit from 50 to 234 feet."

Preparation of Material Removed by Erosion

As previously stated and described, the materials which are removed and washed into the streams are first prepared through *weathering* processes. Particles are loosened from the outcrop by surface disintegration, consisting largely of oxidation, hydration, and solution.

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[64] Longwell, Knopf, and Flint, A Textbook of Geology, Part I., Physical Geology: John Wiley & Sons, 1932. pp. 42–44.

Since climatic environments were different in the past than they are now, the subject of ancient climates[65] is an important problem in its relation to the development of ancient stream channels. The study of fossils imbedded in the deposits gives the most important clue to the nature of ancient climates. The condition and composition of the sediments themselves give another, as repeatedly pointed out by Reed.[66]

Transportation

The subject of river engineering brought forth at an early date much definite information as regards the carrying power of streams. The following statement is quoted from Stevenson:[67]

> "The following are results deducted from experiments made by Bossut, Dubuat, and others, on the size of detrital particles which streams flowing with different velocities are said to be capable of carrying:
>
> 3 in. per sec.—0.170 mile per hour, will just begin to work on fine clay.
> 6 in. per sec.—0.340 mile per hour, will lift fine sand.
> 8 in. per sec.—0.4545 mile per hour, will lift sand as coarse as linseed.
> 10 in. per sec.—0.5 mile per hour, will lift gravel the size of peas.
> 12 in. per sec.—0.6819 mile per hour, will sweep along gravel the size of beans.
> 24 in. per sec.—1.3638 miles per hour, will roll along rounded pebbles 1 inch in diameter.
> 3 ft. per sec.—2.045 miles per hour, will sweep along slippery angular stones the size of a hen's egg."

The following table is quoted from F. C. Gilbert[68] to show the maximum diameters of boulders which can be moved in sluices at certain velocities:

Diameter (inches)	Velocity (feet per second)
2	3.3
4	5.3
6	6.2
8	7.4
10	8.4
12	9.1
16	10.8
20	11.9
24	13.0
30	13.7

Transportation, as shown by McGee,[69] is done by the carrying of materials in *solution,* through *suspension,* and by the process of *saltation.* The materials thus carried are deposited by *precipitation* from solution, *sedimentation* from suspension, and *grounding* after 'leaping' along by that process called 'saltation.'

It has been shown by G. K. Gilbert,[70] who carried on extensive laboratory experiments with running water, that the materials borne in suspension are easily enough sampled and their quantity measured; but the 'bed load' is much less accessible. This load is carried forward by sliding or rolling along a smooth channel bed, as well as by saltation, which takes place when the bed is uneven and causes the particle to move irregularly in a series of jumps.

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[65] Smith, J. P., Ancient Climates of the West Coast: Pop. Sci. Monthly, vol. 76, 1910, pp. 478–486.

Smith, J. P., Climatic relations of the Tertiary and Quaternary Faunas of the California region: Cal. Acad. Sci., Proc. (series 4) vol. 9, 1919, pp. 123–173.

[66] Reed, R. D., Geology of California: Am. Assoc. Pet. Geol.

[67] Stevenson, David: The principles and practice of canal and river engineering: Edinburgh, 1886, p. 361.

[68] Gilbert, F. C., Design of sluices for gold placer mining: Eng. Jour. (Ariz.), vol. 16, no. 8, 1932, p. 4.

[69] McGee, W J, Outline of hydrology: Geol. Soc. Am., Bull. 19, 1908, p. 199.

[70] Gilbert, G. K., The transportation of débris by running water: U. S. Geol. Survey, Prof. Paper 86, 1914, pp. 10, 11, 15, 16.

Gilbert calls the transportation of the bed load *hydraulic traction* in contrast to *hydraulic suspension.* His summary of "Modes of transportation, collective movement" is expressed as follows:

> "When the conditions are such that the bed load is small, the bed is molded into hills, called dunes, which travel downstream. Their mode of advance is like that of eolian dunes, the current eroding their upstream faces and depositing the eroded material on the downstream faces. With any progressive change of conditions tending to increase the load, the dunes eventually disappear and the débris surface becomes smooth. The smooth phase is in turn succeeded by a second rythmic phase, in which a system of hills travel upstream. These are called antidunes, and their movement is accomplished by erosion on the downstream face. Both rhythms of débris movement are initiated by rhythms of water movement."

In showing how complicated a stream's action may be, Gilbert states:

> "The flow of a stream is a complex process, involving interactions which have thus far baffled mechanical analysis. Stream traction is not only a function of stream flow but itself adds a complication. Some realization of the complexity may be achieved by considering briefly certain of the conditions which modify the capacity of a stream to transport débris along its bed. Width is a factor; a broad channel carries more than a narrow one. Velocity is a factor; the quantity of débris carried varies greatly for small changes in the velocity along the bed. Bed velocity is affected by slope and also by depth, increasing with each factor; and depth is affected by discharge and also by slope. If there is diversity of velocity from place to place over the bed, more débris is carried than if the average velocity everywhere prevails, and the greater the diversity the greater the carrying power of the stream. Size of transported particles is a factor, a greater weight of fine débris being carried than of coarse. The density of débris is a factor, a low specific gravity being favorable. The shapes of particles affect traction, but the nature of this influence is not well understood. An important factor is found in form of channel, efficiency being affected by turns and curvature and also by the relation of depth to width. The friction between current and banks is a factor and therefore likewise the nature of the banks. So, too, is the viscosity of the water, a property varying with temperature and also with impurities, whether dissolved or suspended."

Gilbert classifies streams according to their transportational characters:

> "The classification of streams here given has no other purpose than to afford a terminology convenient to the subject of débris transportation.
>
> "When the débris supplied to a stream is less than its capacity the stream erodes its bed, and if the condition is other than temporary the current reaches bedrock. The dragging of the load over the rock wears, or abrades, or corrades it. When the supply of débris equals or exceeds the capacity of the stream bedrock is not reached by the current, but the stream bed is constituted wholly of débris. Some streams with beds of débris have channel walls of rock, which rigidly limit their width and otherwise restrain their development. Most streams with beds of débris have one or both banks of previously deposited débris or alluvium, and these streams are able to shift courses by eroding their banks. The several conditions thus outlined will be indicated by speaking of streams as *corrading,* or *rock-walled,* or *alluvial.* In strictness, these terms apply to local phases of stream habit rather than to entire streams. Most rivers and many creeks are corrading streams in parts of their courses and alluvial in other parts.
>
> "Whenever and wherever a stream's capacity is overtaxed by the supply of débris brought from points above a deposit is made, building up the bed. If the supply is less than the capacity, and if the bed is of débris, erosion results. Through these processes streams adjust their profiles to their supplies of débris. The process of adjustment is called gradation; a stream which builds up its bed is said to aggrade and one which reduces it is said to degrade.
>
> "An alluvial stream is usually an aggrading stream also; and when that is the case it is bordered by an alluvial plain called a flood plain, over which the water spreads in time of flood.
>
> "If the general slope descended by an alluvial stream is relatively steep, its course is relatively direct and the bends to right and left are of small angular amount. If the general slope is relatively gentle, the stream winds in an intricate manner; part of its course may be in directions opposite to the general course, and some of its curves may swing through 180° or more. This distinction is embodied in the terms *direct alluvial* stream and *meandering* stream. The particular magnitude of general slope by which the two classes are separated is greater for small streams than for large. Because fineness is one of the conditions determining the general slope of an alluvial plain, and because the gentler slopes go with the finer alluvium, it is true in the main that meandering streams are associated with fine alluvium."

Commenting on the curvature of a channel, which greatly complicates the transportation and deposition of debris by a stream, Gilbert says:

> "In a straight channel the current is swifter near the middle than near the sides and is swifter above mid-depth than below. On arriving at a bend the whole stream resists change of course, but the resistance is more effective for the swifter parts of the stream than for the slower. The upper central part is deflected least and projects itself against the outer bank. In so doing it displaces the slow-flowing water previously near the bank, and that water descends obliquely. The descending water displaces in turn the slow-flowing lower water, which is crowded toward the inner bank, while the water previously near that bank moves toward the middle as an upper layer. One general result is a twisting movement, the upper parts of the current tending toward the outer bank and the lower toward the inner.[1] Another result is that the swiftest current is no longer medial, but is near the outer or concave bank. Connected with these two is a gradation of velocities across the bottom, the greater velocities being near the outer bank. The bed velocities near the outer bank are not only much greater than those near the inner bank, but they are greater than any bed velocities in a relatively straight part of the stream. They have therefore greater capacity for traction, and by increasing the tractional load they erode until an equilibrium is attained. On the other hand, the currents which, crossing the bed obliquely, approach the inner bend are slackening currents, and they deposit what they can no longer carry.
>
> "It results that the cross section on a curve is asymmetric, the greatest depth being near the outer bank. As the winding stream changes the direction of its curvature from one side to the other, the twisting system of current filaments is reversed, and with it the system of depth, but the process of change includes a phase with more equable distribution of velocities, and this phase produces a shoal separating the two deeps. The shoal does not cross the channel in a direction at right angles to its sides but is somewhat oblique in position, tending to run from the inner bank of one curve to the inner bank of the other. In meandering streams it is usually narrow and is appropriately called a bar. In direct alluvial streams, where bends are apt to be separated by long, nearly straight reaches, it is usually broad and may for a distance occupy the entire width of the channel."

Deposition

The nature of stream or fluvial deposits and their detailed structure and texture is described in various textbooks, but not with sufficient detail to explain all the types of complicated features found in gravel deposits, especially complex deposits such as those of a mountainous region like the Sierra Nevada.

Quoting from Longwell, Knopf, and Flint[71] on "fluvial deposition":

> "The constructive process of fluvial deposition goes forward side by side with fluvial erosion. This is a result of the complexity and variability of the stream currents, which constantly drop some rock fragments to the bottom while they pick up others. When a stream is actively eroding its bed at a certain point, it is merely picking up and carrying away more rock material than it is depositing there, and when it is actively depositing the reverse is going on. Therefore, whereas fluvial erosion and deposition are processes physically opposed to each other, they can be separated in practice only by recognizing the preponderance of one over the other."

The arrangement of materials deposited in a delta, however, is well known, and gives a picture which is more or less duplicated whenever the current of a stream is checked by a body of standing water and the materials transported are permitted to drop. The term *foreset beds* is applied to the deposition on the frontal slope of the growing embankment. *Bottomset beds* are of finer grain and are formed by the particles carried out beyond the slope and deposited in deeper water. *Topset beds* are composed of the materials laid down and spread out on top of the other materials by the fluctuating stream.

The material deposited by a stream is called alluvium and makes up *fan, floodplain,* and *delta* deposits. The term *fanglomerate* is used for the gravel materials of alluvial fans.

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[1] The system of movements here described has been observed by many students of rivers. They were demonstrated by the aid of a model channel by J. Thomson, in connection with an explanation which differs somewhat from that of the present text. See Roy. Soc. London Proc., pp. 5–8, 1876, and 356–357, 1877; also Inst. Mech. Eng. Proc., pp. 456–460, 1879.

[71] Longwell, Knopf, and Flint, *op. cit.*, p. 44.

An alluvial fan is built up at the point of abrupt change in gradient of a loaded stream. A floodplain is a series of coalescing alluvial flats along a valley. A delta is the final deposit by a stream, unloaded as it enters a still body of water.

Overflow of a stream onto its floodplain will cause *natural levees* to be built up as low ridges bordering the channel. Lateral swinging of a stream causes cutting on the outer sides of the curves and deposition on the inside, which results in the widening of the valley. A meandering stream may develop to the point of straightening itself in places by the cutting off and silting up of the meanders, forming *oxbow* lakes as a result. A stream which forms a complex interlocking network on its floodplain typifies *anastomotic* drainage. An overloaded stream on a low gradient, becoming choked, and constantly obliged to cut new channels, develops an intricate network on a floodplain; the process is termed *braiding.*

If the stream is rejuvenated and therefore cuts deeper, floodplain *terraces* or *benches* are formed. The benches may, however, be cut and left in the bedrock and covered with only a film of gravel on the surface.

Streams composed entirely of thick mud, called *mudflows,* are akin to landslides.[72] Quoting from Longwell, Knopf, and Flint:[73]

> "Another normal though infrequently operative process in arid regions is the *mudflow.* It occurs only where fine rock material becomes water-soaked on steep slopes after heavy rains, and moves downward as a slippery mass. . . . It advances in waves, stopping when it becomes too viscous to flow and damming the water behind it until it liquefies and again proceeds like an advancing flow of lava. Mudflows can carry boulders many feet in diameter. Observers have seen these great rocks bobbing 'like corks in a surf.' Successive mudflows play a part in the building of fans."

The transporting power of mudflows, their various peculiarities, and the resultant unsorted deposits have many characteristics much like those of glacial deposits and have frequently deceived engineers.

The distinguishing characters of glacial deposits are clearly summarized by Blackwelder,[74] who has made a special study of them:

> "The deposits left by glaciers should be distinguished from those made by streams, lakes and other agencies.
>
> "The ice tongue of a glacier leaves only one type of deposit called *till.* It is wholly unstratified and its components are quite unsorted—a jumbled orderless mass of clay, sand, and boulders. Blocks three to five feet in diameter are common and those 25 feet or more are not rare. In general, the size of such boulders depends upon the spacing of the joint-cracks in the rocks of the mountain sides. Usually till is an earthy mass well sprinkled with stones and boulders but in some cases the boulders predominate. This is particularly true of the deposits of small glaciers which have done little more than sweep the coarse talus from the valley slopes. The stones in till may be of any shape from well-rounded to angular but many have the corners and edges rounded. It is usual to find some that have been bevelled by being rasped along the bottom of the glacier. Hard rocks may thus be well polished. Such stones, like the bedrock, are covered with scratches which are easily recognized.
>
> "It is often difficult to identify till, especially if it has been much decayed or eroded or is poorly exposed. It may then be confused with other bouldery deposits which are unstratified. From volcanic mudflow deposits, such as abound in the Miocene beds on the Sierra Nevada flanks, till may often be distinguished by its containing large quantities of nonvolcanic rocks. Even this criterion fails where glaciers occupied volcanic mountains such as Mts. Shasta and Rainier. Ordinary mudflow deposits are seldom as thick as glacial moraines and are generally interbedded with typical stream gravel and sand, as in the alluvial fans of the arid regions. Unless the surface topography is still preserved or unless one finds

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[72] Blackwelder, Eliot, Landslide family and its relations: (Abstract) Pan. Am. Geol., vol. 54, 1930, p. 73.

Finch, R. H., Mud flow eruption of Lassen volcano: The Volcano Letter, No. 266, 1930, pp. 1–4.

[73] Longwell, Knopf, and Flint, *op. cit.,* pp. 77–78.

[74] Blackwelder, Eliot, Glacial and associated stream deposits of the Sierra Nevada: State Mineralogist's Rept. XXVIII, 1932, pp. 306–308.

plenty of scratched stones, it may be almost impossible to distinguish till from landslide dumps. In many cases no one type of evidence can be relied on, but one must study all the facts and weigh the importance of each.

"The rivers which issue from glaciers deposit coarse gravel, then fine gravel, and finally sand as the current weakens near the edge of the mountains. These three grades of detritus are more or less interbedded, because variations in the river's power occur from time to time at a given place. Like river deposits in general, those of glacial streams are distinctly stratified, though usually cross-bedded. They are fairly well sorted into separate layers of sand and gravel of various sizes. The pebbles are normally well rounded and very rarely either faceted or scratched. Angular stones are rare. Although small boulders are carried by ice cakes and become stranded in the glacial river gravel, large boulders are generally absent.

"To distinguish the deposits of a glacial from a nonglacial river is difficult and often impossible, unless one can trace the gravel terraces into actual connection with a glacial moraine or can work out in detail the physiographic history of the district.

"The deposits made in glacial lakes are rather distinctive. On the bottom of the lake, clay and silt are laid down very evenly in thin sheets which are commonly banded as seen later in cross-section. This is due to the fact that the layer deposited in winter is finer and darker in color than the one laid down during the summer melting season. Unlike most lake deposits the glacial lake clays commonly contain scattered pebbles and even small boulders which have been dropped from cakes of ice floating over the lake. These laminated clays may be associated with beds of peat or chalky or diatomaceous earth formed by organisms that inhabited the clearer parts of the lake. Streams entering the lake form advancing deltas composed of gravel and sand in which the stratification is characteristic of deltas in general. In quantity the delta deposits often exceed the other lake deposits greatly, for the glacial rivers carry large quantities of coarse detritus all of which lodges in the deltas rather than upon the floor of the lake.

"Other deposits that may be formed in glacial valleys, such as landslides, talus, and alluvial fans, need not be described specifically. They are local and generally well known."

The deepening of canyons and the deposition of gravels by outwash streams which issue from the snouts of glaciers form a very important chapter in the robbing and destruction of earlier gold-bearing gravels. Much of the material carried by Pleistocene glacial outwash streams of the Sierra Nevada was dumped at the foot of the western slope of the range at the point where the major rivers enter the Great Valley. The extensive gold-dredging ground of California to a large extent owes its existence to these streams.

So far as the processes involved in stream action are concerned, much can be gained by the detailed study of ancient glacial stream channels found throughout the world, especially in its northern belt. The mass of literature published on this subject should contribute greatly to the building up of a systematic knowledge of stream habit.

Physiographic Terms Relating to Streams

The mere definition of some of the terms used in stream physiography gives a direct insight into the science.[75]

Cycle of Erosion includes the series of changes from the *initial* cutting of a surface to the final reduction of a region to a *baselevel.* The surface of a region reduced to fairly low relief, but still undulating, it called a *peneplain* (also spelled *peneplane*). It is a significant fact that the Sierra region in early Tertiary time was approaching the peneplain stage of erosion, when the area was covered with lava to form a more nearly plain-like surface, and later uplifted. The uplift caused deep dissection by streams.

Stages of stream development, from gulleys to completely worn-down plains, consist of *youth, maturity,* and *old age,* with continuous transitional stages between. The early stages represent very rapid growth, which slows down gradually until at old age the changes may be extremely slow.

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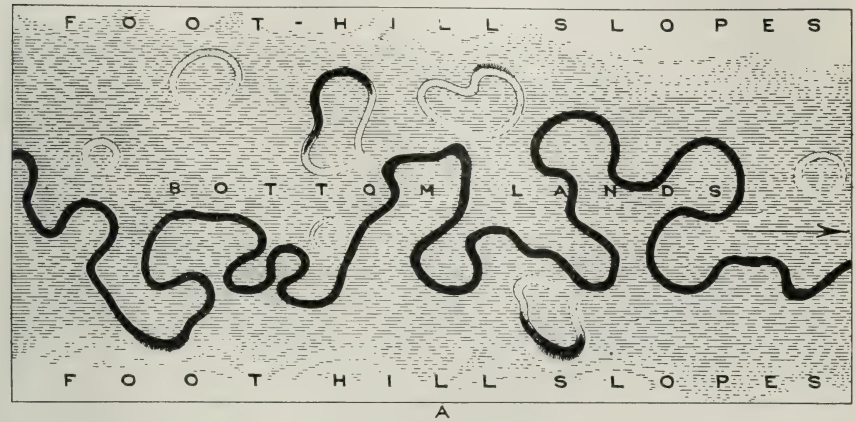
[75] Johnson, Douglas, Streams and their significance: Jour. Geol., vol. 40, 1932, p. 482.

The *genesis* or origin of the stream takes into consideration the initial surface over which the stream first flowed. Several terms are used by geologists in relation to this subject. *Consequent* streams are those whose positions were determined by the initial slopes of the land surface. *Subsequent* streams are those which are established by growing headward along belts of weak rocks.



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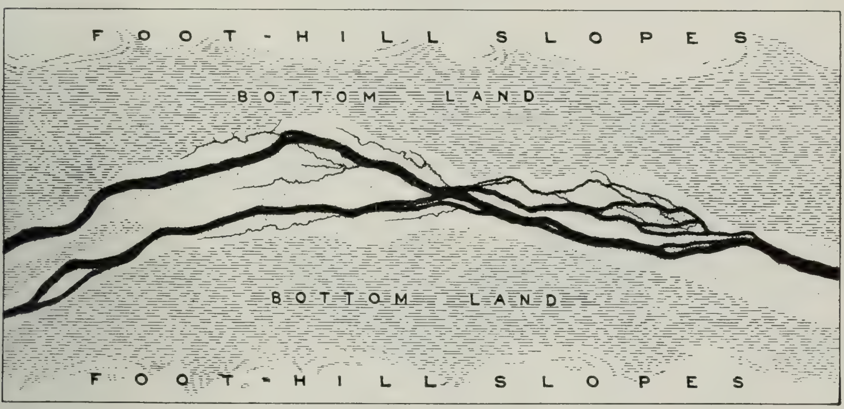

B

FIG. 26-A. Diagram to show a meandering stream with oxbow loops. Such a stream develops in a valley worn down to base-level and not subject to extensive floods.

FIG. 26-B. Diagram to show a subdividing or *anastomosing* stream in a valley subject to floods. *(After Johnson, U. S. G. S., 22d An. Rept., 1900.)*

Where the underlying structures of the rocks have affected the direction of the stream and its valley, the stream is said to have *structural control.* The terms *fault, joint, strike, anticlinal, synclinal,* and *monoclinal* are prefixed to the word 'valley'; thus, *fault-valley, strike-valley,* etc. It is especially significant that the richest gold-bearing channels have structural control—the streams originally ran on and along mineralized zones in bedrock.

Streams may start their courses over one sort of geological formation, but as time progresses they may cut through it and be *let down* on a lower and entirely different type of structure; such streams are said to be *superimposed* (or simply *superposed*) on the underlying rock structure. When a certain stream *pattern*, originally developed because of previous topographic or structural conditions, is retained even after those conditions are removed, the stream is said to have *inherited* its peculiar features from much earlier periods of its life.

Streams may be *intermittent* or *permanent*. Depression of topography along a coast may cause the sea to invade the valleys, and the streams are *drowned*. Uprise along the coast may leave *hanging valleys*. Tributaries to a main stream which has been much faster-cutting

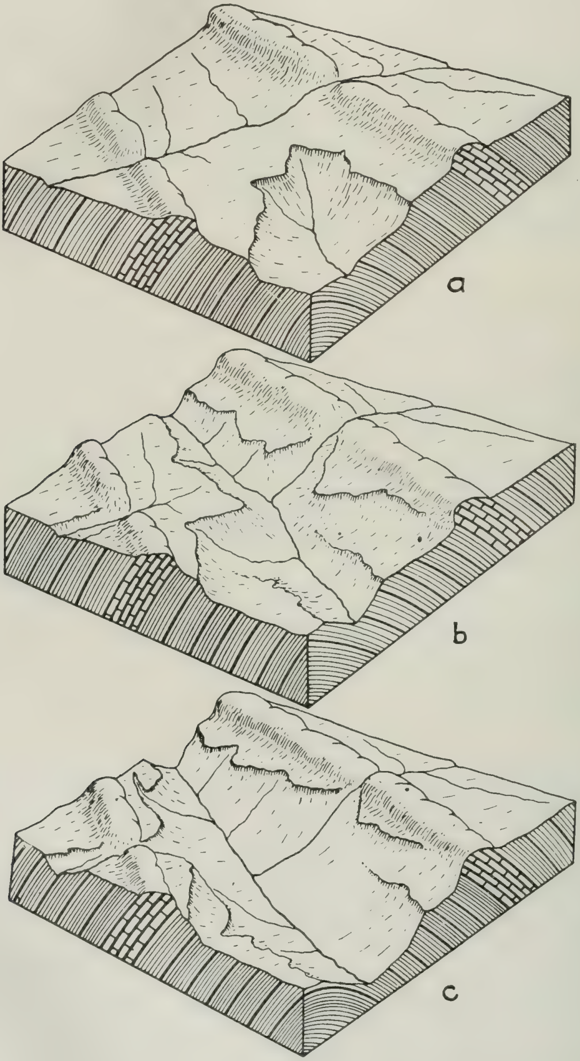

FIG. 27. Diagrams to illustrate three successive stages in *stream piracy*. The stream cutting back at the lower elevation beheads and captures the stream flowing at a higher level. *(After Blackwelder and Barrows, Am. Book Co.)*

may also be left 'hanging'; as, for example, in Yosemite Valley where the side streams reach the Merced River by way of beautiful waterfalls.

The *longitudinal profile* of a stream is taken from its source to its mouth, while its *gradient* represents its inclination at some particular part of its course. Tributaries are said to be *accordant* when they enter at about the same level as their main stream. A stream is said to be *at grade* when rate of degradation and rate of aggradation are about equal.

A stream which is able to maintain its course, even when a segment of the earth is gradually raised athwart that course, is called an *antecedent* stream. If, however, the uprise of the mountain causes the flow of the streams to be accelerated down its slope, so that they cut deeper gorges, they are said to be *rejuvenated.* Even stream *meanders,* developed on a plain, may be *entrenched* or *incised* deeply, to form a winding canyon by elevation of the plain.

Rejuvenation may be effected in other ways than mountain-making. Change of climate may make a decided change in stream cutting. Stream *piracy* is another important cause. This consists of the *capture* of one stream by another. The second lies at a lower elevation; its head cuts back until the first is tapped, or *beheaded.* Then the water from the first stream, from that point upward, is caused to flow into the capturing stream. In this manner the flow in the first is accelerated often to such an extent that a new gorge may be formed. Whole stream systems may thus be *readjusted* and repeatedly go through new life cycles. Piracy and stream adjustment were apparently very active in the Sierra Nevada during Tertiary time; this process partly accounts for many of the deep accumulations there of Tertiary gravel.

The *pattern* of an individual stream, or of the whole or any part of its system, develops in its own peculiar way because of certain controlling geological, topographical, and climatic features. The pattern, therefore, is a character significant enough to bear special study and to support many new descriptive terms. It is now best studied by means of aerial photographs, though detailed topographic and geologic maps once presented the only bases of accurate expression.

Many clues as to the geologic structure and history of the underlying region are gained by the study of stream pattern, from either an intensive or regional point of view. In the northern Sierra Nevada, the stream pattern developed prior to volcanic activity was structurally controlled by bedrock; but during the later period of volcanism it suffered change by that widespread activity. The major streams subsequent to volcanism followed the slope of the lava-covered, tilted, and uplifted fault-block-range.

An instructive outline of the subject of stream pattern is given by Zernitz.[76] who describes and illustrates by many actual examples such patterns as follows: *dendritic, trellis, rectangular, annular, radial,* and *parallel.* He states that:

> "The patterns which streams form are determined by inequalities of surface slope and inequalities of rock resistance. This being true, it is evident that drainage patterns may reflect original slope and original structure or the successive episodes by which the surface has been modified, including uplift, depression, tilting, warping, folding, faulting, and jointing, as well as deposition by the sea, glaciers, volcanoes, winds, and rivers. A single drainage pattern may be the result of one or of several of these factors."

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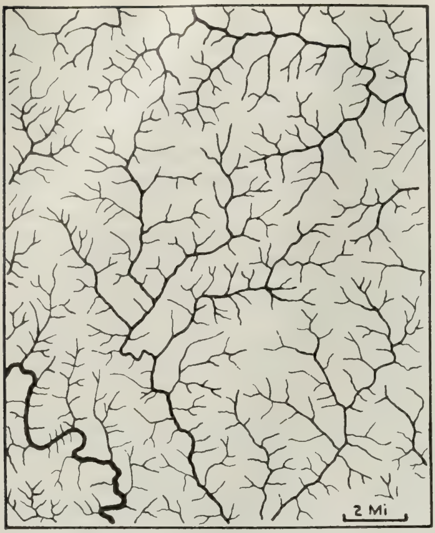
[76] Zernitz, Emile, Drainage patterns and their significance: Jour. Geol., vol. 15, 1932, p. 498.



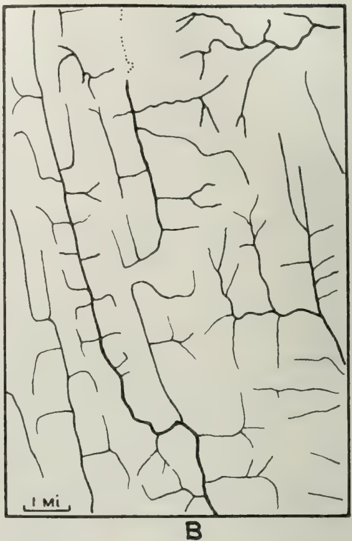


FIG. 28-A. An example of *dendritic* drainage pattern, which develops where the underlying rocks lie in a hortizontal position and offer uniform resistance to erosion. *(After Zernitz, Jour. Geol., 1932.)*

FIG. 28-B. An example of trellis drainage pattern, which develops in folded rocks differing in degrees of resistance to erosion. The stream courses are therefore *structurally controlled. (After Zernitz, Jour. Geol., 1932.)*

The fact that lakes fill depressions, basins, and valleys along stream courses, and that their deposits are intimately associated with those of streams, makes their study interrelated with that of stream channels. The so-called 'pipe-clay' deposits, which nearly always immediately overlie the gold-bearing gravels, represent beds of silt and finely divided volcanic ash, which have settled in lakes and formed a series of thin layers. They often contain impressions of leaves, showing the character of the forests that grew in that early period. This feature indicates that before the volcanic flows came to cover them up, the stream valleys had been transformed into lakes, into which the volcanic ash settled.

In general, a lake is not as long-lived as a stream. Streams tend to destroy lakes, either by gradually filling their basins with detritus or by cutting down their outlets to a point where their basins may be drained. Sometimes, however, lakes persist long enough so that the area whose drainage they receive is worn down to a *local* and *temporary baselevel.* Lakes are formed in a number of ways: by landslides across stream courses; by lava flows which dam up the drainage; by the down-faulting of segments of the earth which are then filled with water; by glacial action, either by scooping out rock basins or by damming with till; by peculiar action of rivers themselves, such as silting off oxbow loops in a meandering course. An excellent paper written by the late Dr. W. M. Davis has recently been published, which not only discusses the present lakes of California,[77] but the origin of lakes in general.

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[77] Davis, William Morris, The Lakes of California: Cal. Jour. Mines and Geol., Div. of Mines, State Mineralogist's Rept. XXIX, 1933, pp. 175–236.

Desert Processes

In the desert, the processes of erosion and of stream action differ very much from those in more humid areas. Only quite recently have the geologic processes in the desert been given much consideration; so also has much serious thought only lately turned toward the possible development of desert placers on a larger scale than mere 'dry washing'. The fact that adequate supplies of water may usually be derived from underground sources in the desert, and the fact that these sources may be found through geological investigation and geophysical surveying, are gradually being accepted.

The most significant results of recent desert-process studies are summarized by Blackwelder [78] as he describes the five distinct types of desert plains:

1. Pediments (including those only thinly veneered with alluvial fans), which represent the desert slope, cut in bedrock, in contrast to the built-up thick alluvial fans or bajadas.

> "Pediments are essentially compound graded floodplains excavated by ephemeral streams * * * the pediment, not the bajada, is the normal and inevitable form developed in the arid regions under stable conditions."

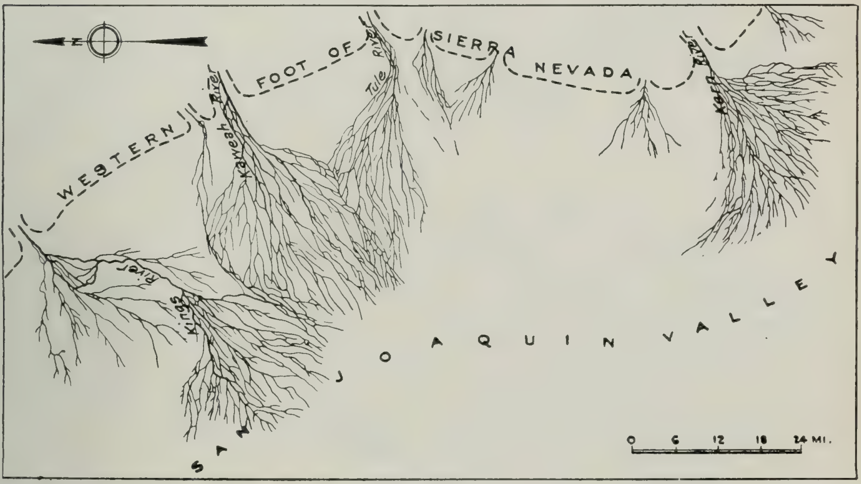

FIG. 29. Map of the southeastern margin of the San Joaquin Valley showing fans built by streams which disappear after leaving their mountain canyons. The coalescing alluvial fans form in this manner an extensive *bajada*. *(After Slichter, U. S. G. S., W. S. P. 67, 1902.)*

2. Bajadas [79] (compound alluvial fans), which are built up largely as a result of disturbed or interrupted development of graded slopes. The upward movement of a fault block causes renewed erosional activity, and thick gravel deposits are formed by the consequent torrents and mudflows when they are released from their canyons and enter a region of lesser gradient.

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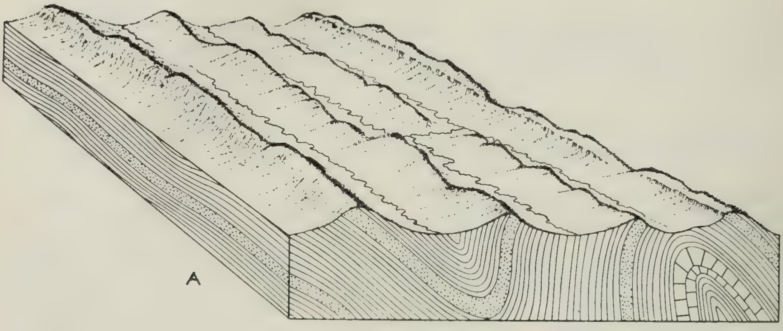
[78] Blackwelder, Eliot, Desert plains: Jour. Geol., vol. 39, 1931, pp. 133–140.

[79] The name *bajada placer* as adopted somewhat erroneously by Webber and previously described in this paper, refers more to single alluvial fans rather than to these compound forms.

3. Dried-up lake bottoms of the desert, or playas, whose conditions indicate that once more permanent lakes filled the flats and were fed by streams that are now nonexistent.
4. Dip slopes, which are broad planes developed on a denuded, hard, flat-lying or gently tilted rock layer.
5. River floodplains, which are abnormal desert features, but which were apparently more widespread at an earlier time, when precipitation in a given region was much greater than it is today.

These earlier plains and stream courses have been covered by the bajadas of today, so that the older channels have become buried in the true sense of the word. Some of them may represent a large potential placer reserve, but they have not yet been well investigated.



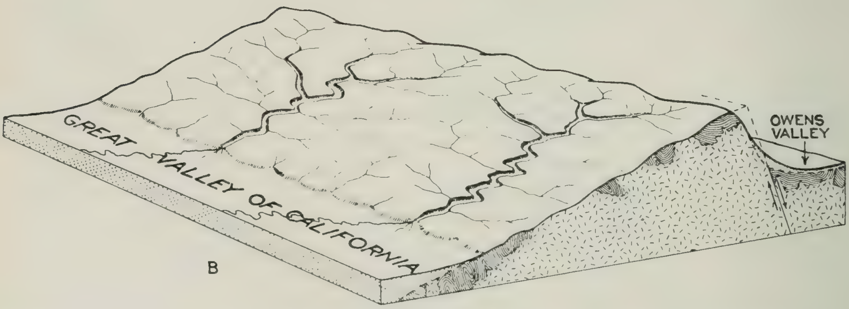


Fig. 30-A. Block diagram illustrating Cretaceous Sierra Nevadan topography. The upturn edges of bedrock controlled the drainage pattern, which was later inherited by streams of the early Eocene period. *(After Matthes, U. S. G. S., P. P. 160, 1930.)*

Fig. 30-B. Block diagram to show the tilting of the Sierra Nevada and its effect on stream cutting. Erosion, prior to the tilting, planed down the surface and exposed the granite, leaving only occasional fragments of the intruded metamorphic rock bodies as *roof pendants*. The streams, at the point where they leave their mountain canyons and enter the Great Valley, form alluvial fans. *(After Matthes, U. S. G. S., P. P. 160, 1930.)*

Need for Establishment of Working Criteria

From the study of the complicated life history and habit of streams and the processes involved in their development, a series of working criteria should be developed by the exploration geologist for interpreting the conditions found in the deposits of all streams, including those of Tertiary age in the Sierra Nevada. There is no text available that completely covers all phases of streams—their life history, habits, deposits, etc., especially as this study is related to placers, but the subject offers an interesting field of research which would have a very broad economic application.

GEOLOGIC CONDITIONS IN THE GOLD PROVINCES OF CALIFORNIA

In the Sierra Nevada and Klamath Mountains of California gold-bearing quartz veins are generally found in metamorphic rocks not more than a few miles, at the most, from intrusive bodies of granitic rocks. The age of the metamorphics, which are made up of slates, schists, limestones, and meta-igneous bodies, is earlier than Cretaceous, namely pre-Paleozoic, Paleozoic, Triassic, and Jurassic. The time of intrusion of the granitic masses was late Jurassic.

The quartz veins were formed shortly after the igneous intrusion, during the last stages of the Jurassic. It would seem that the metamorphic rock masses were uplifted and intruded by molten magmas which then cooled and contracted, causing the surrounding and overlying roof-rocks to crack along many planes of weakness and to form thousands of fissures. Into these openings the residual gaseous solutions, released from the crystallizing granites and composed largely of silica, were injected. These, after solidifying, were crushed again, and solutions containing gold entered the complex mineralized zones, enriching especially the cross-fractures where openings were most abundant.

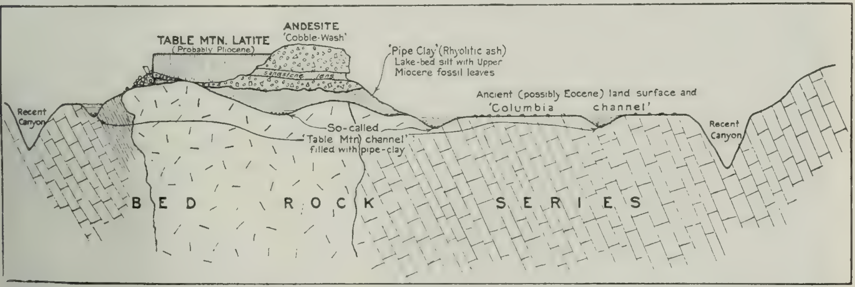


FIG. 31. Diagrammatic geologic cross-section of Table Mountain in the vicinity of Columbia, Tuolumne County. The following principal geologic events affecting the ancient channels of the district are graphically illustrated:

1st. An early Tertiary surface, developed on bedrock over which flowed the old river system of the Columbia basin.
2nd. This surface, including its rich gold-bearing gravels, was later covered with lake sediments ('pipe-clay') consisting of fine silty volcanic ash.
3rd. Andesite 'cobble-wash' then covered the entire country.
4th. A canyon was cut in this andesite mudflow.
5th. A basic lava (latite) flowed down this canyon as a molten stream.
6th. After this lava cooled and hardened, it became the bed of another river which deposited some gold-bearing gravels on its surface, washed in from the surrounding eroded region.
7th. Continued erosion during the Pleistocene resulted in the washing away of the less resistant volcanic materials, leaving the very resistent latite standing as Table Mountain. Furthermore, the earlier prevolcanic bedrock surface was uncovered, or resurrected, exposing the gold-bearing gravels originally deposited in the Columbia channel system.
8th. Quaternary erosion has cut canyons of great depth, far below the level of the former Tertiary surfaces.

The gold-bearing veins thus formed deep beneath the surface of the earth, had then to be brought to the light of day by the erosion and removal of the covering layer of rocks, nearly two miles in depth.

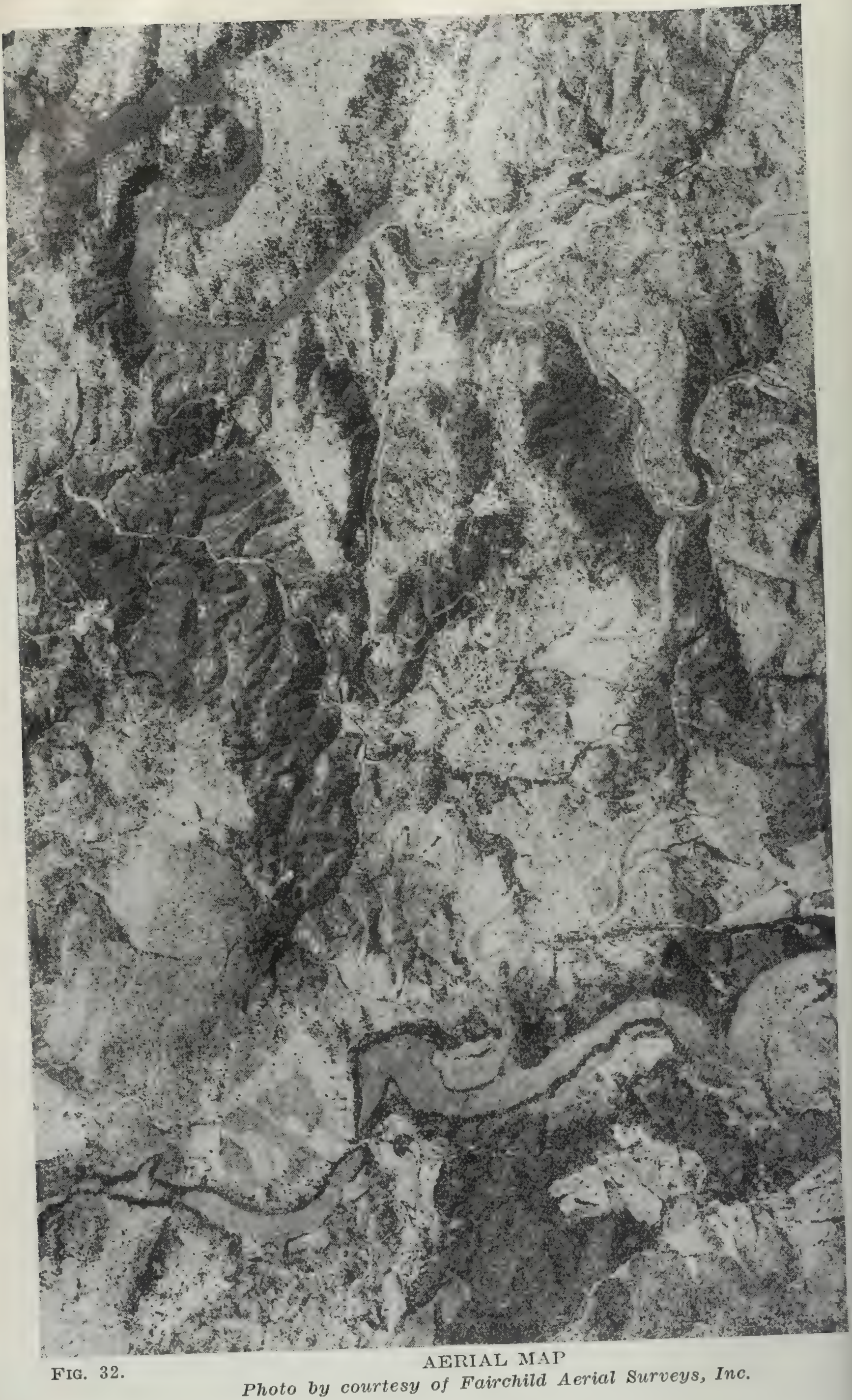


FIG. 32. AERIAL MAP

Photo by courtesy of Fairchild Aerial Surveys, Inc.

[See explanation at bottom of page 195.]

This gigantic work was accomplished during the Cretaceous period, and as a result thousands of layers of shales, sandstones, and conglomerates several miles in stratigraphic thickness were laid down in an adjoining marine basin. Some of these beds—especially the last ones to be deposited—are gold-bearing, showing that the last part of the Cretaceous erosion finally reached the hidden veins.

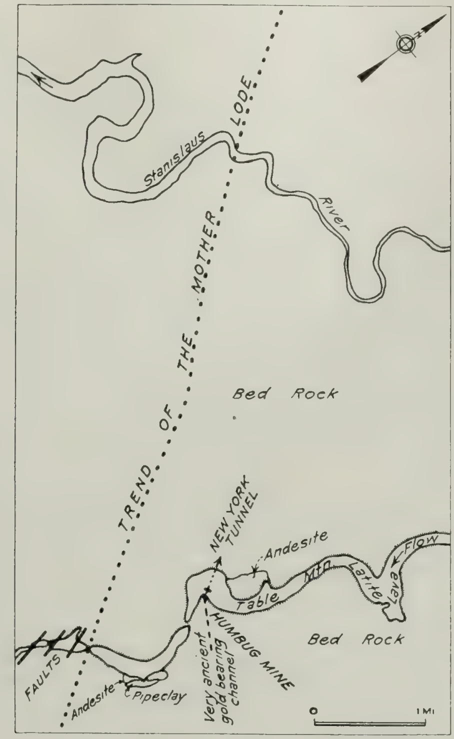


FIG. 33. Index sketch (reduced) of the same area shown in Fig. 32.

That part of the geologic history, however, which was most important so far as the making of rich placer deposits is concerned, was the Eocene period. The deep erosion which took place during the Cretaceous had worn the surface down to such an extent that the

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[Explanation of Fig. 32, on opposite page.]

Mosaic of many overlapping vertical photographs taken from an airplane, elevation 10,000 feet; area 6½ x 4 miles, between Jamestown and Angels Camp on the Mother Lode. (See Index, Fig. 33.) The Stanislaus River winds through the upper half of the picture; in the lower, the Table Mountain latite flow, which occupies a late Tertiary canyon cut in andesite 'cobble-wash,' stands out in bold relief. The softer andesite rocks and the underlying 'pipe-clay' cut by this canyon have been stripped away by Pleistocene erosion, save for two or three small patches remaining in protective curves of the harder lava flow. The surrounding country lies lower than Table Mountain in elevation, and is worn in bedrock. The prevolcanic gold-bearing channels are represented only as gravel-filled fragments, which, however, show their north-south trend, parallel to the strike of bedrock and the Mother Lode. These remnants can be recognized in the pictures only after field examination. One such mined-out channel passes under Table Mountain at right angles to it, near its central position in the picture. It was here that the Humbug drift mine on the south met the New York tunnel on the north, resulting in an underground fight, and later litigation.

metamorphic rocks with their mineralized zones had been reached, so that the streams of the Eocene ran along and through them.

Structural control of the drainage, fully developed during the Cretaceous, was thus inherited by the Eocene streams. Ridges and valleys followed the north-south trending beds of hard and soft rock. The subtropical climate of the early Eocene together with other conditions particularly favorable to rock disintregation, such as a more prolonged time of stability in the earth's crust, made it possible for the gold in the surface rocks to be released from its matrix.

Then came the inception of the Tertiary Sierran uplift, which rejuvenated stream flow, causing the released gold in the disintegrated veins to be washed into the river channels, resulting in very rich concentrations. The streams were loaded with fine quartz sand and pebbles, together with clays derived from the decomposed feldspathic parts of the rocks. The finer particles were washed to the sea, and as a result the Eocene (Ione formation) today contains large deposits of commercial clay interbedded with quartz sands.

The westward tilting and resulting acceleration of stream flow interrupted the north-south drainage system inherited from the Cretaceous period. The readjustment of the streams resulted in their general direction of flow being finally changed from north and south trends to a westerly course, somewhat as it is today. The longest of these known streams even headed far to the east into what is now Nevada.

Hardly had the Eocene come to a close when much rhyolite ash, thrown into the air from volcanoes, settled over the region. By Oligocene time, rhyolite ash had covered much of the northern Sierra Nevada, damming rivers and forming lakes, the bottom sediments of which are now represented by thinly layered pipe-clay immediately overlying the richer gold-bearing gravel. The newly developed rivers, flowing directly down the western-tilted slope of the Sierra, over a volcanic cover, as consequent drainage, were repeatedly interrupted by continued ejections of lava and a further tilting of the region. Not until the late Pliocene or early Pleistocene did the constant outpouring of lava cease. Then, by a series of violent earth movements, the Sierra Nevada broke away from the region to the east along huge fault-scarps, which are formed at the foot of the present steep eastern slope, where displacements are now measured in thousands of feet. Within the Sierran slope, smaller adjustment faults also broke the continuity of the older buried Tertiary stream grades. Some of the ancient streams, the courses of which headed farther to the east, were virtually 'chopped' into many pieces; some were elevated and others depressed, and many were warped to various peculiar positions. Undoubtedly there are some segments of these old channels which now lie deeply buried beneath great thicknesses of alluvium in down-dropped fault-blocks east of the Sierran escarpment.

In the Great Basin and the Mojave Desert region of California and Nevada are remnants of Tertiary stream deposits, interbedded with or lying beneath lavas, all of which have suffered much by faulting and warping.

In these regions, however, the most important period of placer formation was in the early Pleistocene, rather than in the Tertiary.

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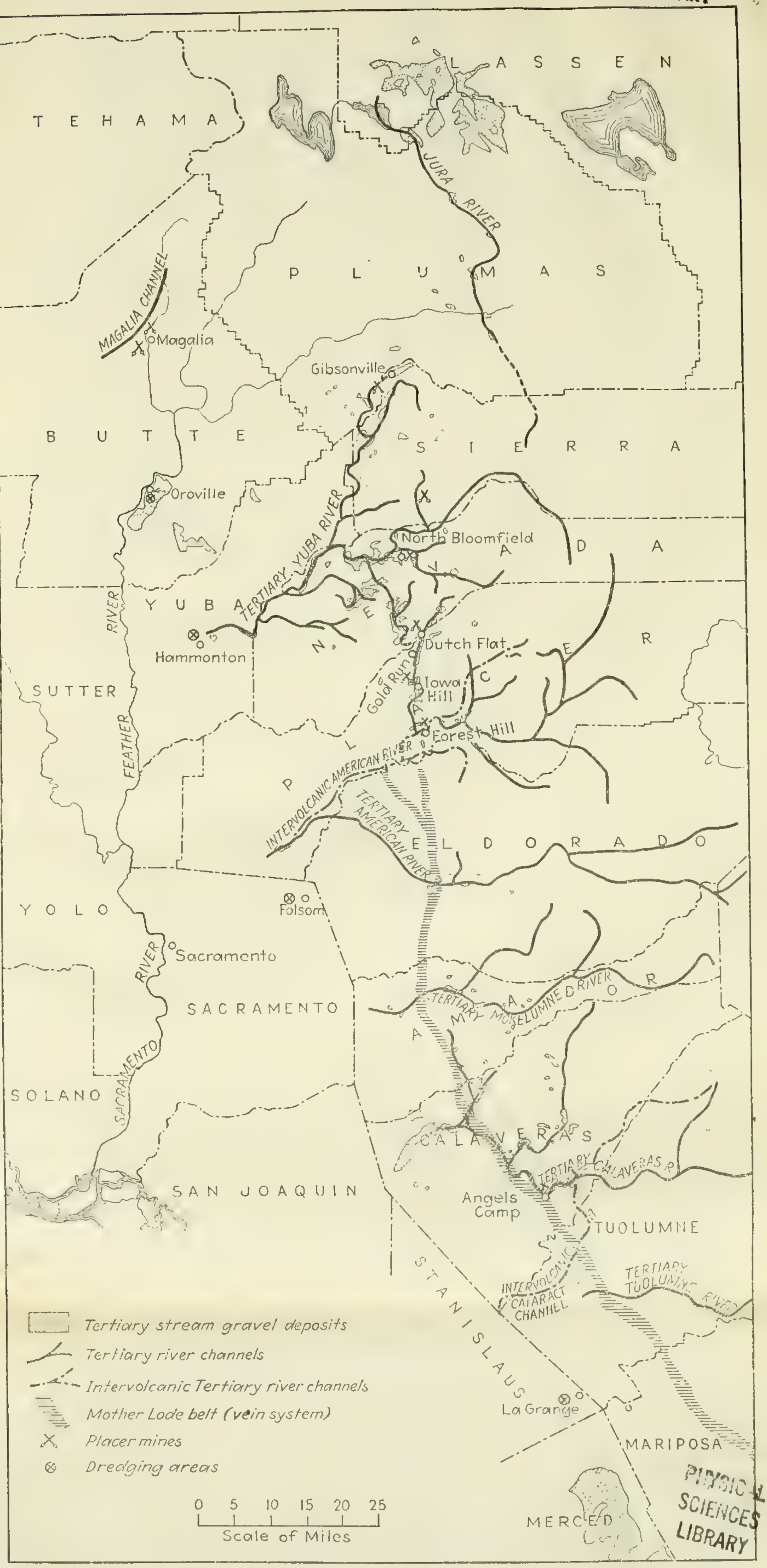
LASSEN
TEHAMA
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PLUMAS
MAGALIA CHANNEL
Magalia
Gibsonville
BUTTE
SIERRA
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TERTIARY YUBA RIVER
North Bloomfield
NEVADA
YUBA
Hammonton
Dutch Flat
PLACER
Gold Run
Iowa Hill
Forest Hill
SUTTER
FEATHER RIVER
INTERVOLCANIC AMERICAN RIVER
TERTIARY AMERICAN RIVER
EL DORADO
YOLO
Folsom
Sacramento
RIVER
SACRAMENTO
AMADOR
TERTIARY MOKELUMNE RIVER
SOLANO
SACRAMENTO
CALAVERAS
TERTIARY CALAVERAS R
SAN JOAQUIN
Angels Camp
TUOLUMNE
INTERVOLCANIC CATARACT CHANNEL
TERTIARY TUOLUMNE RIVER
STANISLAUS
La Grange
MARIPOSA
MERCED
Tertiary stream gravel deposits
Tertiary river channels
Intervolcanic Tertiary river channels
Mother Lode belt (vein system)
Placer mines
Dredging areas
0 5 10 15 20 25
Scale of Miles

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PLATE III. Map showing the main courses of the Tertiary river channels as mapped by Lindgren and other members of the U. S. Geological Survey. The position of the Mother Lode and various Tertiary gravel deposits are also shown, together with the location of some of the principal placer mines. *(Prepared from map by Jenkins, State Div. Mines; cut by courtesy of E. & M. J., Nov. 1934.)*

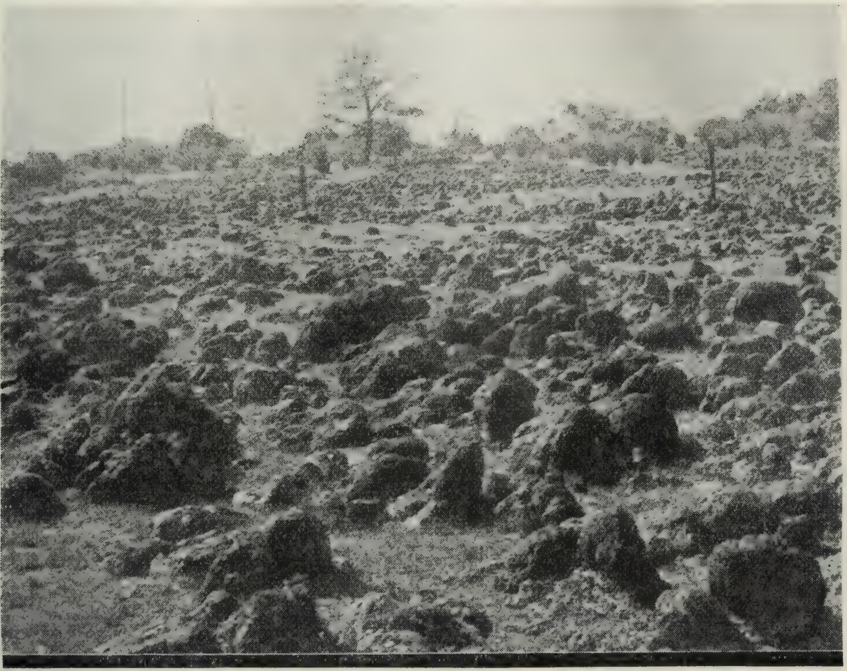

FIG. 34. Surface of the resistant Table Mountain latite lava flow which once filled a canyon cut by a river in andesite 'cobble-wash'. Later the latite surface served as a stream bed; now it is the flat mountain top in Tuolumne and Calaveras counties referred to in the writings of Mark Twain and Bret Harte. *(Photo by Jenkins: cut by courtesy of E. & M. J.)*

Two types of lode gold supplied the source. One type was formed in much the same manner as the Sierra Nevada loads. The other consisted of mineralized zones in rhyolite of early and middle Tertiary time. In the Pleistocene there were normal streams flowing through the desert, fed by melting glaciers of the higher mountains. Placers that were formed by these Pleistocene streams have since been largely covered by desert alluvial fans. Some have been elevated and are cut by more recent streams, when present in this arid region, so that recent concentrations from older river gravels provide one source for the desert dry placer.

In the Klamath Mountains, though the early geologic history was much like that of the Sierra Nevada, there were no lavas to fill the valleys in which the stream gravels were deposited. Uplifts, accompanied by renewed stream-cutting, caused terraces to be left on the valley sides, where the rich gravels have given up their gold to hydraulic mining. Some of the finer gold particles were washed by the rivers to the sea and have formed deposits known as beach placers along the northern shore of California.

Down-faulting of various degrees of magnitude in places caused accumulations of gravels to form, especially on the down-throw sides of faults. A number of such faults are located in both the Sierra Nevada and Klamath Mountains, and may hold a reserve of gold not yet entirely recovered. In the Sierra most of these minor displacements show that the east side of the fault-plane has been dropped down, so that where faults cross westward flowing rivers, accumulations of gravels have taken place in pockets thus formed, east of the fault-plane and upstream.

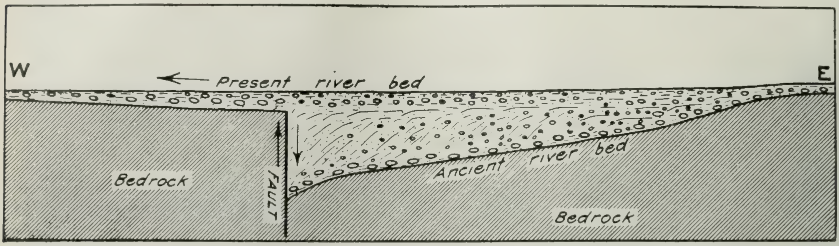

FIG. 35. Ideal cross-section of a river in the Sierra Nevada, the bed of which has suffered down-faulting on the upstream side, causing gravels, sand, and silt to accumulate in the pocket thus formed.

The whole Pleistocene period was one of great events for California. The eastern side of the Sierra Nevada was raised to very lofty heights. The westward-flowing streams, as a consequence, were so greatly accelerated that they cut deep and rugged canyons. The uprise, accompanied by faulting, caused such violent earthquakes that enormous masses of rock were shaken from the mountain sides, in many places to form local lakes which were later to be drained and destroyed by active erosion. Glaciers developed in the higher mountains and crept down the canyons, carving them wider and leaving them U-shaped in form. Their melting supplied much water to the streams. Some local volcanic cones were built up here and there near or over the fault planes.

The Tertiary stream gravels, which had long been buried deeply beneath lavas, were exposed by the Pleistocene canyon-cutting rivers. From the dissected portions of the old channels, gold was removed and washed into the newer streams, which concentrated it on their bedrock riffles. The remaining portions of the Tertiary deposits were left with their stubs exposed high up on the intervening ridges. In places, erosion merely stripped the covering of volcanic tuffs, sands, and gravels from the bedrock, leaving the channel with its rich gold deposits laid practically bare for the lucky early miner to win. Some of the finer particles of gold were swept clear out to the Great Valley where they were dropped on the edge of the plain. These areas are now the dredge grounds.

The general western tilt of the Sierra Nevada has been found to continue along the same slope (about two degrees) far beneath the alluvium and sediments of the Great Valley. Areas dredged for gold values in the gravels thrown down by the great canyon-cutting rivers of the range lie along the extreme western margin of the foothills near the place where bedrock passes beneath the alluvium, and aligned in a direction N.20°W. The gravels dredged do not lie directly on bedrock but on tuffaceous clay layers, spread out above the detritus-covered down-warped Sierran surface. Beneath the 'false-bedrock' and cut in the true bedrock surface is a stream pattern with gold-bearing gravel-filled channels, now reached only in one or two places. This buried channel system undoubtedly holds in reserve a great wealth for future improved exploration and development. Excessive underground water is always encountered in these mines which are located beneath the level of the alluvial plain.

The great differences between the geology of the Coast Ranges and that of the Sierra and Klamath regions are fundamental in that the western area served frequently as a basin for deposition during the Tertiary and Cretaceous, while the latter represented land areas throughout that time. The Coast Ranges together with the Great Valley now contain enormous accumulations of marine Tertiary and Cretaceous sediments, while the Sierra Nevada and Klamath Mountains are not so covered. Cretaceous and Tertiary streams coursing down the mountain flanks brought gravel, sands, and clays into a marginal sea.

The very fact that streams are conveyors of materials, in contrast to the basins of deposition toward which they flow, accounts for the very different geologic conditions on the two sides of the Great Valley. Certain geologic time divisions of the Cretaceous and Tertiary of the Coast Ranges are represented by strata measured in many thousands of feet, while in the Sierra mere films of Tertiary gravels, or deposits of no greater thickness than a few hundred feet, trapped by volcanic coverings, represent some of these same later periods. Particles of gold, recurrently washed from the mineralized rocks of the mountain range, were dropped, by reason of their high specific gravity, and retained in the bedrock riffles of both the ancient and modern streams, while the lighter detritus was carried to the broad sea basins to form strata covering hundreds of square miles.

CONCLUSION

The depletion of the more accessible and more easily discovered gold placers, followed by losses due to poorly directed exploration, calls for a more effective technique to bring further success to placer mining. The technique is available; the next thing to do is to apply it.

First, there is aerial photography which may speedily and accurately give a wealth of valuable information as regards geology, and in addition, the finest sort of a map showing surface features in greatest detail.

Second, there is geophysical surveying which, when coordinated with geology, may greatly aid underground prospecting in making new discoveries and in reducing its cost by more intelligently directing its course of action.

Third, physiographic geology, advanced to a more systematic science than ever before, may be used in unravelling the history of the ancient streams and their corresponding topography. Contouring the pre-lava surface is found to be an excellent method of showing graphically this ancient topography, and especially the old valleys in which lay the early gold-bearing streams.

Fourth, a better understanding of desert processes in general and desert placers in particular should help to develop a gold reserve which has so far not received the attention it deserves.

Fifth, the technique recently developed in the examination of stratified sediments, their structure, texture, mineral-grain composition, etc., may be aptly applied to placers, to aid in tracing out their origin and the courses of the older drainage systems now extinct.

In taking stock of the possible reserves of placer gold in California, several sources would seem worth investigating. All of these require detailed exploration prior to any attempt at mining. For the most part, these reserves are buried or concealed in such a way that they have either been overlooked or considered too remote or too much of a speculation for a mining venture. Such factors as involved water-rights, litigation, difficulty in gaining title, laws unfavorably affecting hydraulic mining, lack of sufficient capital, and many other stumbling blocks now prevent good placer ground from being worked.

The possible reserves discussed in this report may be summarized as follows:

Pleistocene and Recent Placers.

1. Deep river gravel deposits, over which the present larger rivers are now flowing. Recent and Pleistocene faulting caused gravel to be accumulated on the down-throw side of faults, while the rivers have continued to flow over the gravels without washing them completely out.
2. Pleistocene stream placers, buried beneath alluvial fans of the Great Basin and Mojave Desert.
3. Recent ephemeral stream deposits and alluvial fans or 'bajada placers' of the Great Basin and Mojave Desert regions.
4. Marine or beach placers along the coast, for the most part located in northern California.
5. Isolated high terraces or bench gravels, such as those which occur in the Klamath Mountains.

Tertiary Stream Placers.

6. Gold-bearing channels cut in bedrock which lie beneath the false bedrock layers of the dredged areas along the western foot of the Sierra Nevada.
7. Buried Tertiary channels and associated covered benches located in the well-known gold-bearing districts of the state. Large areas still lie buried and unexplored in some of the older mining districts.
8. Buried Tertiary channels and benches in the lava-covered district which lies between the Sierra Nevada and Klamath Mountains. Most of this area is probably too deeply covered to be reached by mining, but the southern marginal area may have some possibilities.
9. Tertiary channels of the Great Basin and Mojave Desert areas, interbedded with volcanic rocks or lying beneath them.
10. Tertiary marine placers. Finely divided gold particles in the Ione formation at the point where the corresponding Eocene streams entered the Ione sea.

Cretaceous Marine Placers.

11. Cretaceous marine placers, largely in the Chico conglomerate (Upper Cretaceous) beds of northern California. The Lower Cretaceous beds are also reported to contain some gold-bearing layers.

Largest Reserve.

The largest of these possible reserves probably lie in the remaining buried Tertiary stream placers of the northern Sierra Nevada.

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OIL FIELD DEVELOPMENT OPERATIONS

R. D. Bush, State Oil and Gas Supervisor

From December 30, 1934, to and including March 30, 1935, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
FRESNO COUNTY:					
Inter-State Lubricants, Inc., and C. R. Butz	10	20 S.	14 E.	1	Coalinga
L. A. McCray	14	20 S.	14 E.	1	Coalinga
Pilot Oil Co.	12	20 S.	14 E.	10	Coalinga
Salvia Oil Co.	14	20 S.	14 E.	12	Coalinga
Tyler, Cederquist & King	14	20 S.	14 E.	1	Coalinga
Wellington Oil Co., Ltd.	14	20 S.	14 E.	1	Coalinga
Kettleman North Dome Assoc.	20	21 S.	17 E.	56	Kettleman North Dome
Kettleman North Dome Assoc.	30	21 S.	17 E.	63	Kettleman North Dome
Kettleman North Dome Assoc.	34	21 S.	17 E.	83	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	54	Kettleman North Dome
Standard Oil Co.	29	21 S.	17 E.	32	Kettleman North Dome
IMPERIAL COUNTY:					
Imperial Carb-Ice Corp.	2	11 S.	13 E.	2	
Pacific-Imperial Dri-Ice, Inc.	13	11 S.	13 E.	10	
KERN COUNTY:					
Belridge Oil Co.	35	27 S.	20 E.	32–35	Belridge
Belridge Oil Co.	35	27 S.	20 E.	33–35	Belridge
Amerada Petroleum Corp.	17	26 S.	19 E.	2	Devil's Den
Chandley Elmer Appling	4	30 S.	29 E.	Appling 1	Edison
Berry Oil Co.	25	30 S.	29 E.	Edison 1	Edison
Chauk Oil Co.	5	30 S.	29 E.	Edison-Seale 5–25	Edison
Edison Oil Co.	15	30 S.	29 E.	C. C. M. O. 2	Edison
General Petroleum Corp.	14	30 S.	29 E.	Leddy-Nichols 4	Edison
General Petroleum Corp.	15	30 S.	29 E.	Osborne 1	Edison
General Petroleum Corp.	24	30 S.	29 E.	Knapp 1	Edison
Gilmore Oil Co.	23	30 S.	29 E.	Gilmore-Stockton 1	Edison
A. T. Jergins Trust	13	30 S.	29 E.	Fee 13 5	Edison
A. T. Jergins Trust	13	30 S.	29 E.	McCowan 13 1	Edison
A. T. Jergins Trust	14	30 S.	29 E.	Dougherty 7	Edison
A. T. Jergins Trust	14	30 S.	29 E.	Hershey 3	Edison
A. T. Jergins Trust	14	30 S.	29 E.	Hershey 4	Edison
A. T. Jergins Trust	14	30 S.	29 E.	Hershey 5	Edison
A. T. Jergins Trust	24	30 S.	29 E.	Johnson 3	Edison
Mohawk Petroleum Co.	3	30 S.	29 E.	Edison-Seale 3 25	Edison
Monterey Exploration Co.	15	30 S.	29 E.	Duff 6	Edison
Monterey Exploration Co.	15	30 S.	29 E.	Duff 11	Edison
Nelco Oil Corp.	5	30 S.	29 E.	Edison-Seale 5–3	Edison
North American Oil Consolidated	14	30 S.	29 E.	Brown 2	Edison
Shell Oil Co.	21	30 S.	29 E.	Twenty-one Comm. 1	Edison
Western Gulf Oil Co.	22	29 S.	27 E.	17-KCL-B	Fruitvale
George F. Getty, Inc.	26	28 S.	27 E.	Grady 3	Kern River
Standard Oil Co.	2	26 S.	20 E.	United 1	Lost Hills
Welport Oil Co.	26	29 S.	21 E.	107	McKittrick
E. R. Bardwell, Trustee	22	32 S.	23 E.	Bull 2	Midway
Getty, Inc.	32	31 S.	23 E.	Fleming 1	Midway
Frank Goldman	22	32 S.	23 E.	2	Midway
Honolulu Oil Corp., Ltd.	14	32 S.	24 E.	13	Midway
Honolulu Oil Corp., Ltd.	14	32 S.	24 E.	15	Midway
Honolulu Oil Corp., Ltd.	14	32 S.	24 E.	35	Midway
Republic Petroleum Co., Ltd.	8	32 S.	23 E.	39	Midway
Standard Oil Co.	15	32 S.	24 E.	23	Midway
Standard Oil Co.	15	32 S.	24 E.	29	Midway
General Petroleum Corp.	16	27 S.	28 E.	Heisen 48	Mt. Poso
General Petroleum Corp.	21	27 S.	28 E.	Glide 21 2	Mt. Poso
Frans Nelson and Co.	33	26 S.	28 E.	S. P. 1	Mt. Poso
O. F. W. Oil Co.	27	26 S.	28 E.	O. F. W. 1	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 15	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 17	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 18	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 19	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder-Rall 7	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder-Rall 8	Mt. Poso
Union Oil Co.	4	27 S.	28 E.	S. & M. 22	Mt. Poso
Union Oil Co.	4	27 S.	28 E.	S. & M. 23	Mt. Poso
Union Oil Co.	4	27 S.	28 E.	S. & M. 24	Mt. Poso
Union Oil Co.	4	27 S.	28 E.	S. & M. 25	Mt. Poso
Union Oil Co.	4	27 S.	28 E.	S. & M. 26	Mt. Poso
Union Oil Co.	4	27 S.	28 E.	S. & M. 27	Mt. Poso
Union Oil Co.	4	27 S.	28 E.	S. & M. 28	Mt. Poso

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued:					
Union Oil Co.	4	27 S.	28 E.	S. & M. 29	Mt. Poso
Barnsdall Oil Co.	32	30 S.	29 E.	Morris 3	Mountain View
General Petroleum Corp.	14	30 S.	28 E.	Brantley 3	Mountain View
The Hancock Oil Co.	14	30 S.	28 E.	Miller 4	Mountain View
The Hancock Oil Co.	14	30 S.	28 E.	Miller 5	Mountain View
The Hancock Oil Co.	14	30 S.	28 E.	Miller 6	Mountain View
Hogan Petroleum Co.	29	30 S.	29 E.	Porter-Day 5	Mountain View
Hogan Petroleum Co.	32	30 S.	29 E.	Wharton 4	Mountain View
A. T. Jergins Trust	24	30 S.	28 E.	Huckeba 5	Mountain View
A. T. Jergins Trust	30	30 S.	29 E.	Wright-Bloemer 3	Mountain View
Mohawk Petroleum Co.	24	30 S.	28 E.	Eisen-Vineyards 2	Mountain View
Mohawk Petroleum Co.	24	30 S.	28 E.	McKeehan 3	Mountain View
Standard Oil Co.	23	30 S.	28 E.	Wible 4	Mountain View
Standard Oil Co.	24	30 S.	28 E.	Ranton 4	Mountain View
The Texas Co.	14	30 S.	28 E.	Mateo Smith 5	Mountain View
Union Oil Co.	15	30 S.	28 E.	Kernco A 5	Mountain View
Union Oil Co.	23	30 S.	28 E.	Wible 4	Mountain View
Vesta Petroleum Co., Ltd.	19	30 S.	29 E.	Merritt 8	Mountaln View
Golden Bear Oil Co., Ltd.	32	27 S.	27 E.	Grimes 3	Poso Creek
The Ohio Oil Co.	32	27 S.	27 E.	Midway Premier 4	Poso Creek
Signal Oil and Gas Co.	10	27 S.	27 E.	Siemon 1	Poso Creek
California Western Oil Co., Ltd.	7	28 S.	29 E.	10	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	55	Round Mountain
Honululu Oil Corp., Ltd.	18	28 S.	29 E.	57	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	58	Round Mountain
Continental Oil Co.	7	25 S.	20 E.	Gatchell 28–7	----------
Continental Oil Co.	7	28 S.	20 E.	Maylan 1	----------
General Petroleum Corp.	1	32 S.	29 E.	Mattson 1	----------
H. B. Oil Co.	6	30 S.	30 E.	Clemens 1	----------
The Hall Baker Co., Ltd.	16	31 S.	30 E.	Tejon 4–4	----------
Reserve Oil and Gas Co.	12	10 N.	19 W.	Tejon Ranch 2	----------
Standard Oil Co.	1	25 S.	23 E.	Title Guarantee & Trust 1	----------
Standard Oil Co.	1	24 S.	23 E.	Widgeon 1	----------
Trico Oil and Gas Co.	3	25 S.	23 E.	4	----------
KINGS COUNTY:					
General Petroleum Corp.	20	24 S.	18 E.	Martin 1	----------
LOS ANGELES COUNTY:					
Standard Oil Co.	13	3 S.	11 W.	Emery 58	Coyote Hills
Standard Oil Co.	13	3 S.	11 W.	Emery 59	Coyote Hills
Shell Oil Co.	33	3 S.	13 W.	Reyes 65	Dominguez
Associated Oil Co.	7	2 S.	14 W.	Vickers 52	Inglewood
Associated Oil Co.	7	2 S.	14 W.	Vickers 60	Inglewood
Pacific Western Oil Co.	8	2 S.	14 W.	Rubel 18	Inglewood
Shell Oil Co.	8	2 S.	14 W.	Rindge 17	Inglewood
Standard Oil Co.	7	2 S.	14 W.	Vickers 1 30	Inglewood
Standard Oil Co.	8	2 S.	14 W.	L. A. Investment Lease 72	Inglewood
Standard Oil Co.	8	2 S.	14 W.	L. A. Investment Lease 73	Inglewood
Standard Oil Co.	8	2 S.	14 W.	Vickers 1 29	Inglewood
Standard Oil Co.	8	2 S.	14 W.	Vickers 1 31	Inglewood
Alamo Oil Co.	29	4 S.	12 W.	Elaine 1	Long Beach
Alum Rock Oil Co., Ltd.	30	4 S.	12 W.	Alum Rock 1	Long Beach
James W. Aregood	30	4 S.	12 W.	Security 1	Long Beach
Bernal Oil Co.	19	4 S.	12 W.	4	Long Beach
Bolsa Chica Oil Corp.	30	4 S.	12 W.	Combs 3	Long Beach
Bunker Hill Co.	30	4 S.	12 W.	Consolidated 1	Long Beach
R. R. Bush Oil Co.	19	4 S.	12 W.	Hillseth 2-A	Long Beach
R. R. Bush Oil Co.	19	4 S.	12 W.	Roan 1	Long Beach
R. R. Bush Oil Co.	29	4 S.	12 W.	H. & W. 1	Long Beach
C. H. B. Oil Co., Inc.	30	4 S.	12 W.	1	Long Beach
C. & N. Oil Corp.	29	4 S.	12 W.	C. & N. 1	Long Beach
Caro-Lyn Petroleum Co.	19	4 S.	12 W.	1	Long Beach
Cherry Hill Co.	29	4 S.	12 W.	Cherry Hill 1	Long Beach
Coastridge Oil Co.	29	4 S.	12 W.	Phillips 1	Long Beach
Commercial Oil and Leasing Corp.	30	4 S.	12 W.	Commercial 4	Long Beach
Consolidated Empire Petroleum, Inc.	30	4 S.	12 W.	Empire 4	Long Beach
D. W. M. Corp.	29	4 S.	12 W.	Corbett 1	Long Beach
Great Western Petroleum Corp.	29	4 S.	12 W.	G. W. P. 1	Long Beach
Huntington Investment Corp.	30	4 S.	12 W.	1-A	Long Beach
Kiowa Petroleum Corp.	30	4 S.	12 W.	Kiowa 2	Long Beach
Medal Oil Co.	29	4 S.	12 W.	3	Long Beach
Medal Oil Co.	30	4 S.	12 W.	2	Long Beach
N. Y. K. Oil Co.	29	4 S.	12 W.	1	Long Beach
Pencole Petroleum	20	4 S.	12 W.	Kilburn 1	Long Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Continued:					
Prosperity Oil Co., Ltd.	30	4 S.	12 W.	Prosperity 1	Long Beach
Shaffer Wintz Oil Co.	29	4 S.	12 W.	Irvine 2	Long Beach
Shell Oil Co.	20	4 S.	12 W.	Marcellus 7	Long Beach
Shell Oil Co.	29	4 S.	12 W.	Cherry Hill Comm. 10	Long Beach
Shell Oil Co.	29	4 S.	12 W.	Wilbur Comm. 7	Long Beach
Union Oil Co.	30	4 S.	12 W.	Long Beach Comm. 26	Long Beach
Williams Petroleum Corp.	30	4 S.	12 W.	1	Long Beach
C. F. Yunker, E. C. Cromwell & Associates	19	4 S.	12 W.	1	Long Beach
Republic Petroleum Co., Ltd.	6	3 N.	15 W.	Price 5	Newhall
Bel Mar Oil Co.	27	2 S.	15 W.	Bel Mar 1	Playa del Rey
Colly Oil Co.	27	2 S.	15 W.	Colly 1	Playa del Rey
Dunlap Petroleum Co.	27	2 S.	15 W.	1	Playa del Rey
D. W. Elliott	27	2 S.	15 W.	Del Rey 1	Playa del Rey
Chas. W. Fourl	27	2 S.	15 W.	Fourl 3	Playa del Rey
Chas. W. Fourl	27	2 S.	15 W.	Fourl 4	Playa del Rey
Lor-Mar Oil Development Co.	27	2 S.	15 W.	Lor-Mar 1	Playa del Rey
Ed McAdams	27	2 S.	15 W.	1	Playa del Rey
The Ohio Oil Co.	28	2 S.	15 W.	Recreation Gun Club 16	Playa del Rey
Raymond J. Rassmussen	27	2 S.	15 W.	Ray 1	Playa del Rey
Royalty Service Corp., Ltd.	27	2 S.	15 W.	Del Rey 1	Playa del Rey
Royalty Service Corp., Ltd.	27	2 S.	15 W.	Pomoc 1	Playa del Rey
Roy Stockburger	27	2 S.	15 W.	Stockburger 1	Playa del Rey
Union Oil Co.	27	2 S.	15 W.	King Vidor 8	Playa del Rey
Union Oil Co.	27	2 S.	15 W.	King Vidor 9	Playa del Rey
Union Oil Co.	28	2 S.	15 W.	Del Rey 8	Playa del Rey
General Petroleum Corp.	5	3 S.	11 W.	Santa Fe 37-B	Santa Fe Springs
General Petroleum Corp.	5	3 S.	11 W.	Santa Fe 46-B	Santa Fe Springs
Union Oil Co.	31	2 S.	11 W.	Bell 76	Santa Fe Springs
Union Oil Co.	31	2 S.	11 W.	Bell 78	Santa Fe Springs
Union Oil Co.	31	2 S.	11 W.	Bell 79	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 73	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 75	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 77	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 80	Santa Fe Springs
Associated Oil Co.	11	5 S.	12 W.	Bryant 14	Seal Beach
Continental Oil Co.	11	5 S.	12 W.	Bixby 36	Seal Beach
Severns Drilling Co.	30	4 S.	13 W.	T-1	Torrance
Republic Petroleum Co., Ltd.	18	3 S.	14 W.	Republic El Segundo 1	----------
MERCED COUNTY:					
Milham Exploration Co.	12	12 S.	11 E.	Ora Loma 1	----------
MONTEREY COUNTY:					
Shell Oil Co.	34	24 S.	10 E.	Branch 1	----------
ORANGE COUNTY:					
Bartholomae Oil Corp.	22	3 S.	10 W.	Stern 2	Coyote Hills
Standard Oil Co.	18	3 S.	10 W.	Murphy-Coyote 121	Coyote Hills
Standard Oil Co.	18	3 S.	10 W.	Murphy-Coyote 122	Coyote Hills
Associated Oil Co.	34	5 S.	11 W.	Dennison 3	Huntington Beach
Concord Oil Co.	35	5 S.	11 W.	3	Huntington Beach
Standard Oil Co.	4	6 S.	11 W.	P. E. 26	Huntington Beach
Stevco Oil Co.	35	5 S.	11 W.	Adele 1	Huntington Beach
SAN JOAQUIN COUNTY:					
Amerada Petroleum Corp.	15	2 S.	5 E.	F. D. L. 1	----------
SAN LUIS OBISPO COUNTY:					
E. M. Bedford	12	10 N.	26 W.	Cuyama Core Hole 1	----------
SANTA BARBARA COUNTY:					
General Petroleum Corp.	32	5 N.	30 W.	Erburu 14	Capitan
Shell Oil Co.	32	5 N.	30 W.	Covarrubias 1 5	Capitan
Casmite Co.	13	9 N.	35 W.	Righetti 1	Casmalia
Barnsdall Oil Co.	15	4 N.	29 W.	88-10	Elwood
Pacific Western Oil Co.	16	4 N.	29 W.	92-14	Elwood
Signal Oil and Gas Co.	16	4 N.	29 W.	Appleford 98 4	Elwood
B. G. M. Oil Co.	28	4 N.	27 W.	Brabo 1	Mesa
Interstate Investment Corp.	28	4 N.	27 W.	1	Mesa
M. & L. Oil Co.	28	4 N.	27 W.	M. & L. 1	Mesa
Geo. Padgham	28	4 N.	27 W.	1	Mesa
Rio Grande Oil Co.	28	4 N.	27 W.	Perkins 5	Mesa
Rio Grande Oil Co.	28	4 N.	27 W.	Perkins 6	Mesa
Rio Grande Oil Co.	28	4 N.	27 W.	Perkins 7	Mesa

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
SOLANO COUNTY:					
Trico Oil and Gas Co.	10	5 N.	1 W.	Noonan 1	
TEHAMA COUNTY:					
Apex Drilling Co.	14	24 N.	3 W.	Flood 1	
TULARE COUNTY:					
Baker-Grover Co.	10	23 S.	27 E.	Baker-Grover 1-A	
VENTURA COUNTY:					
El Rancho Oil Co.	9	3 N.	19 W.	El Rancho 1	Bardsdale
High Mesa Oil Co.	16	4 N.	22 W.	Butcher 1	Ojai
Continental Oil Co.	23	3 N.	24 W.	Grubb 4	Rincon
General Petroleum Corp.	7	3 S.	24 W.	Ferguson 4	Rincon
Supreme Oil Co.	1	4 N.	20 W.	Supreme 1	Sespe
American Drilling Co.	31	3 N.	17 W.	11-A	Simi
Associated Oil Co.	27	3 N.	23 W.	Lloyd 42	Ventura
Associated Oil Co.	27	3 N.	23 W.	Lloyd 77	Ventura
Shell Oil Co.	29	3 N.	23 W.	Taylor 85	Ventura
YOLO COUNTY:					
Morton S. Martin	2	12 N.	3 W.	1	

SPECIAL ARTICLES

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Division as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of the new laws and official regulations and notices affecting the mineral industry.

PRELIMINARY MINE FINANCING

The prospector who makes a new discovery is often pressed for money enough to carry on exploration and development work to a point where a reasonable estimate of the value of his find can be made.

In order to assist in the financing of this preliminary development work the State Division of Corporations is now issuing so-called "Grubstake Permits" for raising funds.

At the request of the State Mineralogist, an outline of the plan, its purpose, and form of application has been prepared through the courtesy of Mr. Edwin M. Dougherty, Commissioner, by Mr. Charles F. Johnson, Assistant Commissioner of Corporations, which follows:

GRUBSTAKE PERMITS

By CHARLES F. JOHNSON, Assistant Commissioner of Corporations

Realizing the necessity of extending all possible assistance to small operators of mining properties in California, the division of corporations recently put into effect what are popularly termed grubstake permits.

Grubstake permits, as the term implies, are for the purpose of making it possible for the so-called prospector or owner of undeveloped mining property to obtain necessary financing to determine whether the prospect merits full development.

COST IS REDUCED

In the past, small and large operators alike have found it necessary to comply with the standard regulations adopted by the division of corporations for the protection of the investing public as well as the legitimate mining industry from the distribution of worthless mining securities.

In attempting to simplify the procedure and to reduce the cost of preparing applications, the commissioner of corporations decided to dispense with certain of these protective regulations where only a small amount of financing is necessary.

DEPOSIT IS ELIMINATED

The regulations which have been most burdensome to the small operator are those relating to impounding the funds, engineering reports and title reports.

In the past, the commissioner has ordinarily required an applicant to accumulate a minimum amount of money to accomplish the proposed development program. This requirement is no longer applicable to grubstake permits, with the result that the small operator not only is saved the expense of depositors fees but is enabled to proceed with his development program as soon as the first funds are received from subscribers.

REPORTS ARE CURTAILED

Formal engineering reports, while indispensible where a large development program is involved, have been found to be unnecessary where only a small amount of money is to be raised and where the immediate purpose is merely to ascertain whether the property warrants extensive development. The commission has accordingly announced that in mining applications involving less than $5,000, a formal engineering report is no longer necessary. Such a report is necessary, of course, if the preliminary development uncovers sufficient showings to warrant extensive financing and development at a later date.

For the protection of the investing public, the Division of Corporations has heretofore required title reports in connection with all programs calling for the development of all property by public subscription and relatively small enterprises. However, the commissioner has found it possible to eliminate this requirement upon the applicant's own statement as to his ownership or interest in the property.

PLAN MEETS APPROVAL

The foregoing changes have been in effect for several weeks in the Los Angeles area and have not only proved feasible but have met with general approval from the small mining man. With this in mind, the Commissioner of Corporations has extended the plan to both the Sacramento and San Francisco offices of his division.

As a further means of reducing the cost and facilitating the preparation of applications, the division is now engaged in preparing a blank form of application which will be generally applicable to this type of enterprise.

ALLOWS SUBSCRIPTIONS

It has been customary for mining men to form corporations prior to undertaking the financing of their development programs. The cost of organizing a corporation, however, has prevented many operators from proceeding particularly where they desired to raise only a small amount of initial capital. As a means of eliminating this expense, the division has recognized setups patterned after the usual grubstake agreements, and providing for subscription by a limited number of people.

MUST GIVE DESCRIPTION

Such an agreement in addition to other matters which the applicant might wish to set forth should contain the following information:

1. A statement by the applicant that the property is either owned outright by him; that he has located the property, or has a lease or option, as the case may be. He should also advise the prospective customer what incumbrance, if any, there is against the property, too. In lieu of an engineering report there should be a reasonably accurate description of the property together with the statement that in the applicant's opinion the expenditure of the sum to be raised (not exceeding $5,000), will put the property in condition to determine whether more comprehensive development is justified. In other words, this plan applies to those situations where a sum of $5,000 should be sufficient to either prove or disprove the property.

SHOULD DEFINE INTERESTS

2. The agreement should define the interests of the subscribing parties in proportion to the amount of their subscriptions and should entitle the subscribers, collectively, to at least a half interest in the property. In this connection, the agreement should also state briefly the type of organization to be used in the event large scale operations become advisable. It is anticipated that this will contemplate the later formation of a corporation and a statement of the rights of the subscribers with respect to any stock which may later be issued under a permit.
3. As is customary in grubstake agreements, it is expected that the operator or applicant will reserve to himself exclusive management during this initial period. In any event the agreement should contain clear provisions regarding management.

FOR SMALL GROUPS

It is expected that a majority of these enterprises will be financed by relatively small groups and that the subscribers will be persons having confidence in the integrety and ability of the applicant.

It is likely that the foregoing provisions will be extended as different situations arise although it will be the policy of the division to confine their applications to cases requiring relatively small amounts of capital.

From the response that has already been received it is expected that this plan will result in preliminary development work on many properties which have heretofore remained undeveloped on account of difficulties encountered in financing.

While the procedure outlined may be considered to apply in the majority of applications for grubstake permits, no hard and fast rules have been promulgated applicable to every application. In other words, each case must be considered on its own merits. It is the experience of the division that no two applications can be exactly alike nor can any two be treated in exactly the same manner because, obviously, a number of factors may be different as between any two applications.

There has been some misunderstanding as to the purpose of the so-called grubstake permits in that some individuals have been led to believe that the Division of Corporations, or some other state agency is in a position to advance funds on the projects. This is an erroneous conception. The Legislature has not made an appropriation to cover such expense, nor has there been laid aside, so far as the Division of Corporations knows, any fund in the State of California from which money could be advanced to prospectors and others desiring to develop or prove small mining properties.

"SUGGESTIONS FOR USE IN PREPARING 'GRUB-STAKE' APPLICATIONS

The application should be verified, as per verification form enclosed, and should contain the following information:

1. A statement by the applicant that the property is either owned outright by him; that he has located the property, or has a lease or option, as the case may be. He should also advise the prospective customer what incumbrance, if any, there is against the property, too. In lieu of an engineering report there should be a reasonably accurate description of the property together with the statement that in the applicant's opinion the expenditure of the sum to be raised (not exceeding $5,000.00), will put the property in condition to determine whether more comprehensive development is justified. In other words, this plan applies to those situations where a sum of $5,000.00 should be sufficient to either prove or disprove the property.
2. The agreement should define the interests of the subscribing parties in proportion to the amount of their subscriptions and should entitle the subscribers, collectively, to at least a half interest in the property. In this connection, the agreement should also state briefly the type of organization to be used in the event large scale operations become advisable. It is anticipated that this will contemplate the later formation of a corporation and a statement of the rights of the subscribers with respect to any stock which may later be issued under a permit.
3. As is customary in 'grub-stake agreements,' it is expected that the operator or applicant will reserve to himself exclusive management during this initial period.
4. A filing fee of $10.00 must accompany the application."

"BEFORE THE
DEPARTMENT OF INVESTMENT, DIVISION OF CORPORATIONS
OF THE
STATE OF CALIFORNIA

In the matter of the application of for a permit authorizing him to sell and issue his securities.	APPLICATION

To the COMMISSIONER OF CORPORATIONS of the State of California:

The undersigned herein makes application for a permit authorizing him to sell and issue his securities by virtue of the execution of a certain subscription agreement, a copy of which is attached hereto marked Exhibit "A" and by this reference is incorporated herein with the same effect as though set forth in full herein.

Applicant represents that his interest in the mining property described in said subscription agreement is (by location), (in fee), (by lease and bond) and that the same is in good standing and unencumbered. (If applicant's interest is by lease and bond copy of same should be attached as Exhibit "B".)

The nature of the property and character of the ore expected to be encountered are as follows:

WHEREFORE, Applicant requests a permit be issued in conformity with the foregoing.

Dated: ________________________

____
Applicant

STATE OF CALIFORNIA } ss.
COUNTY OF }

___________________________________ being first duly sworn deposes and says: That he is the applicant in the above entitled matter; that he has read the foregoing petition and knows the contents thereof; that the same is true of his own knowledge

except the matters stated on information or belief and that as to those matters he believes it to be true.
Subscribed and sworn to before me

this ______ day of ____________, 19___.

____

____
Notary Public in and for the County of

________________, State of California."

"SUBSCRIPTION AGREEMENT

THIS AGREEMENT made and entered into as of the ______ day of __________, 1935, by and between ____________ hereinafter designated as OWNER and the various other persons whose names are subscribed hereto and who are designated as PURCHASERS:

WITNESSETH

THAT WHEREAS, said OWNER represents that he is the OWNER by location in fee, or by lease and option as the case may be, of the following described property, located in ____________ County, California:

that the title to said property is free and unencumbered; that he verily believes that said property contains precious metals in commercial quantities; and that with the expenditure of the sum of ___________ Dollars, said property can be explored and developed to the extent that it can be determined with some degree of certainty that it either merits or does not merit further development and/or operation, and

WHEREAS, the undersigned PURCHASERS desire to finance the OWNER in the preliminary exploration of said property.

NOW, THEREFORE, in consideration of the premises and the mutual and dependent covenants hereinafter set out and contained it is hereby agreed by and between the OWNER and the PURCHASERS as follows, towit:

1. That the PURCHASERS hereby subscribe and agree to pay to OWNER upon demand the sums of money hereinafter set opposite their respective names.
2. That said OWNER agrees to use the sums of money so paid to him for the sole and exclusive purpose of exploring the property described in the preamble of this agreement for the purpose of determining whether or not it merits further development and/or operation.
3. That in the event said exploration work discloses that the property is worthy of further development the OWNER shall cause a corporation to be organized to which title to the property will be transferred. Thereupon such corporation shall forthwith file application with the Commissioner of Corporations of the State of California for permission to sell and issue certain of its shares for cash to obtain sufficient funds with which to carry out the further development and/or operation of the property, in the manner advised by competent engineering counsel, and also to issue shares in exchange for said property which shall be divided equally between the OWNER on the one hand and the PURCHASERS on the other hand.

IT IS FURTHER EXPRESSLY UNDERSTOOD AND AGREED by and between the OWNER and the PURCHASER that the OWNER shall have the sole power to manage said exploration work and expend the subscription money in connection therewith as he may deem advisable.

IT IS STILL FURTHER EXPRESSLY UNDERSTOOD AND AGREED by and between the OWNER and the PURCHASERS that if, in the opinion of the OWNER, after the preliminary exploration work herein contemplated has been performed the property does not warrant and/or justify further development and/or operation that he, the OWNER, shall forthwith assign, set over and transfer to the PURCHASERS collectively as their respective interests may appear, an undivided 50% interest in and to the above described mining property.

IN WITNESS WHEREOF the parties to this agreement have hereunto set their hands.

____
Owner

____

____

____

____

____

____
Purchasers"

ADMINISTRATIVE

WALTER W. BRADLEY, State Mineralogist

Personnel.

There have been no changes of personnel in the Division of Mines to be noted during the past three months.

New Publications.

'CALIFORNIA JOURNAL OF MINES AND GEOLOGY' (quarterly), January, 1935, being Chapter 1, of the State Mineralogist's Report XXXI; price 40 cents, plus 10 cents postage. Contains: 'Review of Gold Mining in East-Central California, 1934; Current Mining Activities in the San Francisco District with Special Reference to Gold'; 'Geological Investigation of the Clays of Riverside and Orange Counties': 'Information Regarding Mining Loans by the Reconstruction Finance Corporation'; 'Estimate of Mineral Production of California for year 1934.'

Bulletin No. 110, 'California Mineral Production and Directory of Mineral Producers for 1933,' by Henry H. Symons; 214 pages, 21 illustrations; price 25 cents, plus 10 cents postage.

Commercial Mineral Notes, Nos. 142–145 (inclusive) February-May, (inclusive) 1935. These 'Notes' contain the lists of 'mineral deposits wanted,' and 'mineral deposits for sale,' issued in the form of a mimeographed sheet monthly. It is mailed free to those on the mailing list for 'CALIFORNIA JOURNAL OF MINES AND GEOLOGY.' As an evidence of the interest in mines and mineral resources now showing considerable activity, this mimeographed 'sheet' has had to be expanded to three and four pages in recent months.

Mails and Files.

The Division of Mines maintains, in addition to its correspondence files and the library, a mine file which includes original reports on the various mines and mineral properties of all kinds in California.

During each quarterly period there are several thousand letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, marketing of refined products and mining law. In addition to this, hundreds of oral questions are answered daily, both at the main office and the district offices, for the many inquirers who come in for personal interviews and to consult the files and library.

MINERALS AND STATISTICS

Statistics, Museum, Laboratory

HENRY H. SYMONS, Statistician and Curator

STATISTICS

The counties of California have produced for some years past more than 50 different mineral substances, the total of which for 1934 was estimated at $254,918,000. See January, 1935, issue of CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

At present (April, 1935) reports for most of the producers are in hand. Data for several substances are now complete and have been compiled, being presented herein. Information at hand indicates that there was no production during 1934 of the following, which have, at one time or another in the past, been on our commercial list: arsenic, antimony, bismuth, graphite, lepidolite, mica, mineral paint, serpentine, shale oil, strontium, titanium, and tin.

There was a single producer in each of the following: asbestos, bromine, carbon dioxide, feldspar, fluorspar, magnesite, manganese ore, molyblenum ore, potash, wollastonite, and zinc.

BARYTES

During 1934 there was a commercial production of crude barytes in California amounting to a total of 21,769 short tons valued at $125,514 f.o.b rail-shipping point, as compared with the 1933 output of 8405 tons worth $49,595. The 1934 output came from Mariposa, Plumas, San Bernardino and Tulare counties, with a single producer in each. This material was consumed in the manufacture of lithopone, in heavy-gravity oil-well drilling-mud, fillers and barium chemicals.

The Tariff Act of 1930 placed a duty on foreign imported barytes ore, crude or unmanufactured, of $4 per ton; ground or otherwise manufactured, of $7.50 per ton.

Present quotations for barytes (93% $BaSO_4$) vary from $6 to $7 (Calif. $7) per ton, crude, f.o.b. rail-shipping point. Most baryte has to be washed and acid treated to remove iron stains or other impurities before being suitable for paint use.

Known occurrences of this mineral in California are located in Inyo, Los Angeles, Mariposa, Monterey, Nevada, San Bernardino, Shasta, Santa Barbara and Tulare counties. The deposits at El Portal, in Mariposa County, have given the largest commercial production to date, in part witherite (barium carbonate, $BaCO_3$). Witherite has also been found in Shasta County, but no shipments have yet been made from the deposit.

BENTONITE (Fuller's Earth)

During 1934 there was produced and shipped in California 6168 short tons of bentonite (fuller's earth) valued at $69,325, coming from seven properties, three of which were in San Bernardino County, two in Inyo County and one each in Kern and San Benito counties. The 1934 output showed an increase, as compared with that of 1933, which was 4605 tons worth $60,621.

Previous to 1931 the Division of Mines classed this material under the heading of 'fuller's earth,' but it was thought advisable to change the name to bentonite, owing to the fact that much bentonite is employed in uses that can not be classed as fuller's earth and therefore has been classified in these reports under pottery clay. This made a confusion in classification. Bentonite is the name commonly applied to the clays of the montmorillonite and halloysite group ('rock soap').

Fuller's earth includes many kinds of unctuous clays. It is usually soft, friable, earthy, nonplastic, white and gray to dark green in color, and some varieties disintegrate in water. Production has come mainly from Calaveras and Solano counties, with other deposits noted also in Riverside, Fresno, Inyo and Kern counties.

The Tariff Act of June 21, 1930, placed a duty of $1.50 a ton on foreign produced imported fuller's earth.

BORATES

During the year 1934 there was produced in California a total of 240,732 short tons of borate materials, compared with 191,950 tons for 1933. The material shipped during the year included the new sodium borates, kernite (rasorite), kramerite from Kern County; also crystallized borax prepared by evaporation of brines at Searles Lake in San Bernardino County and Owens Lake in Inyo County.

As the crude ore is not sold as such, but is almost entirely calcined before shipping to the refinery for conversion into the borax of commerce, and because of the fact that the material varied widely in boric acid content, we have recalculated the tonnage to a basis of 40 per cent, A. B. A. This is approximately the average A. B. A. content of the colemanite material after calcining, and also of the crystallized borax obtained from evaporation of the lake brines.

Recalculated as above, the 1934 production totaled 240,696 short tons valued at $5,524,262. This was an increase in both quantity and value over the 1933 output, which was 197,495 tons worth $3,019,513.

The total amount of borates exported from the United States[1] during the year 1934 was 103,643 short tons valued at $2,997,276, as compared with 87,677 tons worth $2,498,035 in 1933.

CEMENT

During 1934 there was a production in California of 8,936,085 barrels of cement valued at $12,445,616 f.o.b. plant, of which 3,600,153 barrels came from Northern California plants and 5,335,932 barrels from southern California plants. The 1934 output was an increase over that of 1933 which was 7,284,031 barrels worth $10,331,375.

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[1] Monthly Summary of Foreign Commerce of U. S. Bureau of Foreign and Domestic Commerce, Dec., 1934.

Shipments, during 1934, were made from ten plants in nine counties to the extent of 8,591,951 barrels valued at $12,417,337, as compared with those of the previous year, which were 7,369,947 barrels worth $10,520,083. There were operating during the year, five plants in northern California, one each in Calaveras, Contra Costa, Merced, San Mateo and Santa Cruz counties, who shipped 3,357,260 barrels of cement, and five plants in southern California, two in San Bernardino, and one each in Kern, Los Angeles[1] and Riverside counties, who shipped 5,234,691 barrels. There were 1697 men employed in the above plants in 1934.

CHROMITE

During the year 1934 there were shipments of chromite in California amounting to 294 short tons carrying 45% Cr_2O_3, worth $3,498. The 1933 output is placed in the 'Unapportioned' item to conceal the production of either producer of that year. The 1933 shipments were the largest in volume since 1920.

Occurrence.

Chromite is widely distributed in California, the principal production, thus far, having come from El Dorado, San Luis Obispo, Del Norte, Shasta, Siskiyou, Placer, Fresno and Tuolumne counties. In 1918 a total of 29 counties contributed to the state's output. There are two main belts in California yielding this mineral, one along the Coast Ranges from San Luis Obispo County to the Oregon line, including the Klamath Mountains at the north end, and the other in the Sierra Nevada from Tulare County to Plumas County. Chromite occurs as lenses in basic igneous rocks such as peridotite and pyroxenite, and in serpentines which have been derived by alteration of such basic rocks.

Imports.

Imports of foreign chromite[1] duty free, mainly from Rhodesia, New Caledonia and India, totaled 190,797 long tons valued at $2,250,787 for the year 1934, compared with 116,511 tons worth $1,426,450 in 1933.

COAL

Coal produced in California during 1934 totaled 13,549 short tons valued at $52,720, as compared with the 1933 output, which was 2612 tons worth $11,367. The material mined in 1934 came from a single property in each, Amador, Monterey, Santa Cruz and Trinity counties. This coal was consumed by the local market and also used on the property for camp purposes, power and forge, to carry on regular operations and development work.

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[1] Monthly Summary of Foreign Commerce of U. S. Bureau of Foreign and Domestic Commerce, Dec., 1934.

GEMS

The production of gem materials in California has been somewhat irregular and uncertain since 1911. The compilation of complete statistics is difficult owing to widely-scattered places at which stones are gathered and marketed, for the most part in a small way. The gem material reported in California during 1934 had a total value of $2,456 in the rough. The 1934 output came from Amador, Butte, Fresno, Inyo, Kern, Mono, Riverside, San Bernardino and Tulare counties and consisted of diamonds, topaz, beryl, mottled jasper, rose quartz, rutile, blue agate, onyx, and vesuvianite. The above showed an increased value over the 1933 output, which was worth $690.

GYPSUM

During the year 1934 there were shipments of gypsum in California amounting to 58,149 short tons valued at $113,606, coming from two properties, each in Fresno and Riverside counties and a single property each in Imperial and Merced counties. This was a decrease in both quantity and value from the 1933 output, which was 59,235 tons worth $120,451.

IODINE

During 1934, in California, there were three plants producing iodine, all in Los Angeles County, with a total output of 355,279 lbs., valued at $423,016. The 1934 production was a decrease in both amount and value from that of the previous year. The annual details for 1933 were concealed under the 'Unapportioned' item.

Iodine was first produced in California during 1917 to 1921 as a by-product of potash which was reduced from kelp in an experimental station of U. S. Department of Agriculture at Summerland, but after the armistice the demand for these minerals decreased so that the plants in Santa Barbara County closed. In 1929 the General Salt Company erected a plant which reduces iodine from the waste waters of certain deep oil wells in the Long Beach field. During 1933 two more plants started operation, making a total of three producing plants in the State.

LIME

In California during 1934 there was an output of lime to the amount of 32,500 short tons valued at $309,765, coming from two plants each in El Dorado, San Bernardino and Santa Cruz counties, and one each in Alameda and Tuolumne counties. The above figures showed an increased value although there was a slight decrease in amount as compared with that of 1933, which were 33,425 tons worth $271,619.

So far as we have been able to segregate the data, these figures include mainly only such lime as is used in building operations; though they do include a small proportion of calcined lime employed in agriculture and the chemical industries, the figures for which were not separable. A portion is hydrated lime. Limestone utilized in sugar making for smelter flux, as a fertilizer, and other special industrial uses, are classified under 'Industrial Materials.' That consumed in cement manufacture is included in the value of cement.

LIMESTONE

'Industrial' limestone was produced by 20 operators in 9 counties in California during 1934 to the amount of 198,057 short tons valued at $461,139, as compared with the 1933 output, which was 207,371 tons worth $487,712. The 1934 yield came from five properties in Santa Clara County; four in El Dorado County; two each in Fresno, San Bernardino, Santa Cruz, and Tuolumne counties; and one each in Alameda, San Mateo and Ventura counties.

The amount here given does not include the limestone used in the manufacture of cement nor for macadam and concrete, nor of lime for building purposes; but accounts for that utilized as a smelter and foundry flux, for glass and sugar making, and other special chemical and manufacturing processes. It also includes that utilized for fertilizers (agricultural 'lime'), 'roofing gravel,' paint and concrete filler, whiting for paint, putty, kalsomine, terrazzo, paving dust, chicken grit, carbon dioxide gas, 'paving compound,' facing dust for concrete pipe, also for rubber and magnesite mix. The material from Fresno and Ventura counties and one operator in Santa Clara County was marl; and that from Alameda, San Mateo and three operators in Santa Clara counties was shells, dredged from San Francisco Bay, all of which was ground and used for agricultural purposes and poultry grit. Of the total 'industrial' limestone produced in 1934, approximately 52,571 short tons worth $146,262 were used for agricultural purposes and poultry grit.

Distribution of the 1934 output of limestone was as follows:

County	*Tons*	*Value*
El Dorado	112,237	$152,422
Santa Clara [a] [b]	26,809	84,033
Alameda,[b] Fresno,[a] San Bernardino, San Mateo,[a] Santa Cruz, Tuolumne, and Ventura [a] *	59,011	224,684
Totals	198,057	$461,139

* Combined to conceal the output of individual operators in each.

[a] Includes marl.

[b] Includes shells.

MAGNESIUM SALTS

During 1934 there was an output of magnesium salts in California coming from one plant in San Diego County and two in San Mateo County, amounting to 2325 short tons valued at $194,642, and was the chloride and carbonate. The 1934 production was an increase over that of 1933, which amounted to 2073 tons worth $159,660. The chloride was nearly all sold for use in magnesite stucco and cement mixtures (Sorel cement), also some for road liquor. The carbonate, a bulky white powder, was used as a heat-insulating material, as a filler for rubber, paper, paint, etc., and in medicines, in tooth paste, in face powder and as a polish for metal and glass. The sulphate marketed was utilized for medicinal and bath purposes. The material coming from San Diego County was residual bitterns from the salt plants and was in part marketed in the liquid form carrying from 35 per cent to 67 per cent $MgCl_2$ and in part as dry crystals, while that from San Mateo County was magnesium carbonate.

The average value reported for the chloride produced in California in 1934 was approximately $30 per ton, f.o.b. plant.

PUMICE and VOLCANIC ASH

The production of pumice and volcanic ash in California during the year 1934 amounted to 9951 short tons valued at $54,248, coming from three properties in Inyo County and one each in Imperial, Kern, Madera, Mono, Napa, San Luis Obispo and Siskiyou counties. The 1934 output showed an increase in quantity over that of 1933, which was 8242 tons and a decrease in value, which was $61,067. This is accounted for by the fact that the amount of lump pumice showed a decrease in amount while volcanic ash output showed a marked increase.

The material from one of the deposits in Inyo County and from Imperial, Mono, Napa and Siskiyou counties was 2566 tons of pumice and was used in acoustic plaster, light-weight aggregate in concrete, for abrasive purposes and for chicken-house litter. The product from two properties in Inyo and that from Kern, Madera and San Luis Obispo counties was 7385 tons of volcanic ash or tuff variety and was employed in making soap, cleanser compounds, a large tonnage being utilized as a concrete filler in cement displacement, and in asphalt and as a carrier for dry agricultural sprays. The Kern County ash is going into the preparation of one of our popular and nationally advertised brands of cleanser compounds.

SALT

Most of the salt production in California is obtained by evaporation of water of the Pacific Ocean, plants being located on the shores of San Francisco, Monterey and San Diego bays, and at Long Beach. Additional amounts are derived from lakes and lake beds in the desert regions (in part, rock salt), mainly in Inyo, Kern and San Bernardino counties, and evaporation of alkaline lake water in Modoc County. A small amount of valuable medicinal salts has been obtained by evaporation of the water of Lako Mono, Mono County.

During the year 1934, in California there was an output of 332,194 short tons of salt valued at $1,222,810, compared with 321,312 tons worth $1,251,024 in 1933. There were twelve plants operating in 1934, with two each in Alameda and San Bernardino counties, and one each in Imperial, Kern, Los Angeles, Modoc, Mono, Monterey, San Diego and San Mateo counties.

The average value reported for salt produced in California during 1934 was $3.68 per ton f.o.b. plant, as compared with $3.89 in 1933, $3.58 in 1932, $3.73 in 1931, and $3.36 in 1930.

SILICA (Sand and Quartz)

We combine these materials because of the overlapping roles of vein quartz which is mined for use in glass making and as an abrasive, and that of silica sand which, although mainly utilized in glass manufacture, also serves as an abrasive. Both varieties are also utilized to some extent in fire-brick manufacture.

We do not include under this heading such forms of silica as: quartzite, sandstone, flint, tripoli, diatomaceous earth, nor the gem forms of 'rock crystal,' amethyst, and opal. Each of these has various industrial uses, which are treated under their own designations.

The production of silica in California during 1934 amounted to 70,432 short tons valued at $296,693 f.o.b. rail-shipping point, and came from two properties in Contra Costa County and one each in El Dorado, Monterey, Riverside and San Diego counties. The above was an increase in both amount and value as compared with the 1933 output, which was 70,329 tons worth $266,520. The 1934 output consisted of 69,597 tons of glass sand and 835 tons of vein and boulder quartz. In addition to the above output for 1934 there were several thousand tons of quartzite shipped from San Bernardino County to be used in the manufacture of silica brick. To avoid duplication, its amount and value is not added to the silica totals.

The glass sand came from Contra Costa, Monterey, Orange and Riverside counties. For making the higher grades of glass, deposits in Contra Costa County are replacing the sand imported from Belgium. Belgium sand has displaced local material in the manufacture of sodium silicate ('water glass'). There are various deposits of quartz in California which could be utilized for glass making, but to date they have not been so used owing to the cost of grinding and the difficulty of preventing contamination by iron while grinding.

Silica sand has been produced in the following counties of the state: Alameda, Amador, Contra Costa, El Dorado, Imperial, Inyo, Los Angeles, Mariposa, Mono, Monterey, Orange, Placer, Riverside, San Diego, San Joaquin and Tulare, the chief centers being Contra Costa, Amador, Monterey and Los Angeles counties. The industry is of limited importance, so far, because of the fact that much of the available material is not of a grade which will produce first-class colorless glass; for such, it must be essentially iron-free. Even a fractional per cent of iron imparts a green color to the glass.

The Tariff Act of June 21, 1930, placed a duty of $2 per ton on sand, containing 95 per cent or more of *silica* and not more than six-tenths of 1 per cent of oxide of iron and suitable for use in the manufacture of glass.

SLATE

Slate was first produced in California in 1889. Up to and including 1910 such production was continuous, but since then it has been irregular. Large deposits of excellent quality are known in the State, especially in El Dorado, Calaveras and Mariposa counties, but the demand has been light owing principally to competition of cheaper roofing materials.

The production of slate in California for 1934 amounted to 5065 short tons valued at $24,245 f.o.b rail-shipping point, and came from a single property each in El Dorado, Inyo and Tuolumne counties. The 1934 figures showed a decrease in both amount and value from those of the previous year which was 5343 tons worth $31,958. Practically all of this slate was crushed and used for roofing granules.

SODA

The production of sodium salts in California in 1934 included: Soda ash, trona, caustic soda and bicarbonate from plants at Owens Lake, Inyo County, and soda ash, salt cake and trona ('sesqui-carbonate,' a double salt of Na_2CO_3 and $NaHCO_3$) from Searles Lake, San

Bernardino County. There were no shipments of salt cake (sulphate) from the Carrizo Plains, San Luis Obispo County. The output of the year amounted to 99,380 short tons valued at $1,219,561, as compared with the 1933 figures, which were 58,017 tons and $1,019,130.

The dense ash and bicarbonate were used mainly in the manufacture of soap, glass, paper, oil refining, sugar refining, and chemicals; and the trona for metallurgical purposes.

MUSEUM

The museum of the California State Division of Mines possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the five foremost of such collections in North America and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

During the past few months this department has been fortunate in obtaining the help of several SERA workers who were assigned to the task of cleaning and rearranging the cases in the museum. In this work all of the specimens were relabeled, also all of the cases were numbered and an alphabetical index made of all the minerals showing their case arrangement.

This collection has had some 21,000 specimens of rocks, minerals and ores donated to it, since it was established in 1880, having approximately 10,000 on exhibit at the present time, as there is insufficient exhibit space for all. Those not shown, however, are available for reference. There are over 1000 different species of minerals and varieties, many of these being extremely rare. The specimens are arranged in several groups.

The most important of the groups is the one of minerals placed according to the Dana ''System of Mineralogy,'' which places all minerals in eight chemical classes, starting with the ''Native Elements'' (see index of exhibits). Under each of these sections are different subclasses, which are also based on chemical relationships, into which the mineral species is arranged so far as possible, usually including mineral groups having analogous chemical composition and similar crystallization. This group has 51 cases and contains the best samples of each species of mineral contained in the museum. It also contains numerous fine examples of crystallization, and endeavors to show as many forms of crystals as possible for each mineral.

Another group of importance is the county collections. This group occupies 39 cases and gives at least half a case for each county in California. These cases contain mainly minerals of commercial importance and ores of the various metals that are found within the boundaries of the county. Included in this group there are seven additional cases which have commercial minerals and ores from other states and foreign countries.

Fourteen cases are set aside for the ores of the various metals, in which the ores and ore minerals of each metal are grouped together, showing the type of ores from the most important locations throughout the world. There are 14 more cases devoted to commercial, industrial and saline minerals coming from numerous localities.

There is a rock collection in six large cases, each holding about 240 specimens showing practically all kinds of rocks, most of the varieties from several locations. Two of these cases are devoted to rocks coming from the 'Mother Lode' in California, gathered by William H. Storms in 1900, while obtaining data for Bulletin 18, ''Mother Lode Region of California.''

There are 15 tall cases, eight of which have miscellaneous specimens. Most of these specimens are too large for the regular museum cases. The remainder of these cases are devoted to building stones, numerous marbles, granites and sandstones.

There are two gem cases in which many semiprecious gem stones are exhibited, both in the rough and cut. Part of one case contains some high-grade gold specimens. Two safes are devoted chiefly to high-grade gold, some platinum and diamonds. Here is gathered one of the finest aggregates of crystallized gold or 'jewelry' rock made up of mostly California material, but having many excellent specimens from outside of the state. There are also samples of both placer gold and high-grade vein mineral. One shelf in the first safe is devoted to native platinum group metals, all of which originating in California. This safe also has several diamonds coming from Africa and California.

The reading room is just outside of the museum, the walls of which are made as an exhibit of California structural materials, brick, marble and granite, the floors being of tile, marble and magnesite. There is a sandstone railing with granite posts at the ends. The entrance from the reading room to the museum is decorated by an arch made of granite. The library entrance is made of pink and white sandstone on one side, and terra cotta on the other. There are four cases in the reading room, three of which have fossils and oil formation markers, and the other metals (smelter products) mainly reduced from Californian ores.

This collection of minerals has been made up solely by donations and exchanges, as this department has no appropriation to purchase materials for exhibit. Mineral specimens suitable for exhibit purposes are solicited, and such gifts will be appreciated by the Division of Mines, as well as those who utilize the facilities of the division. Since the alphabetic index has been made, several friends of the department have supplied minerals not previously contained in the exhibit.

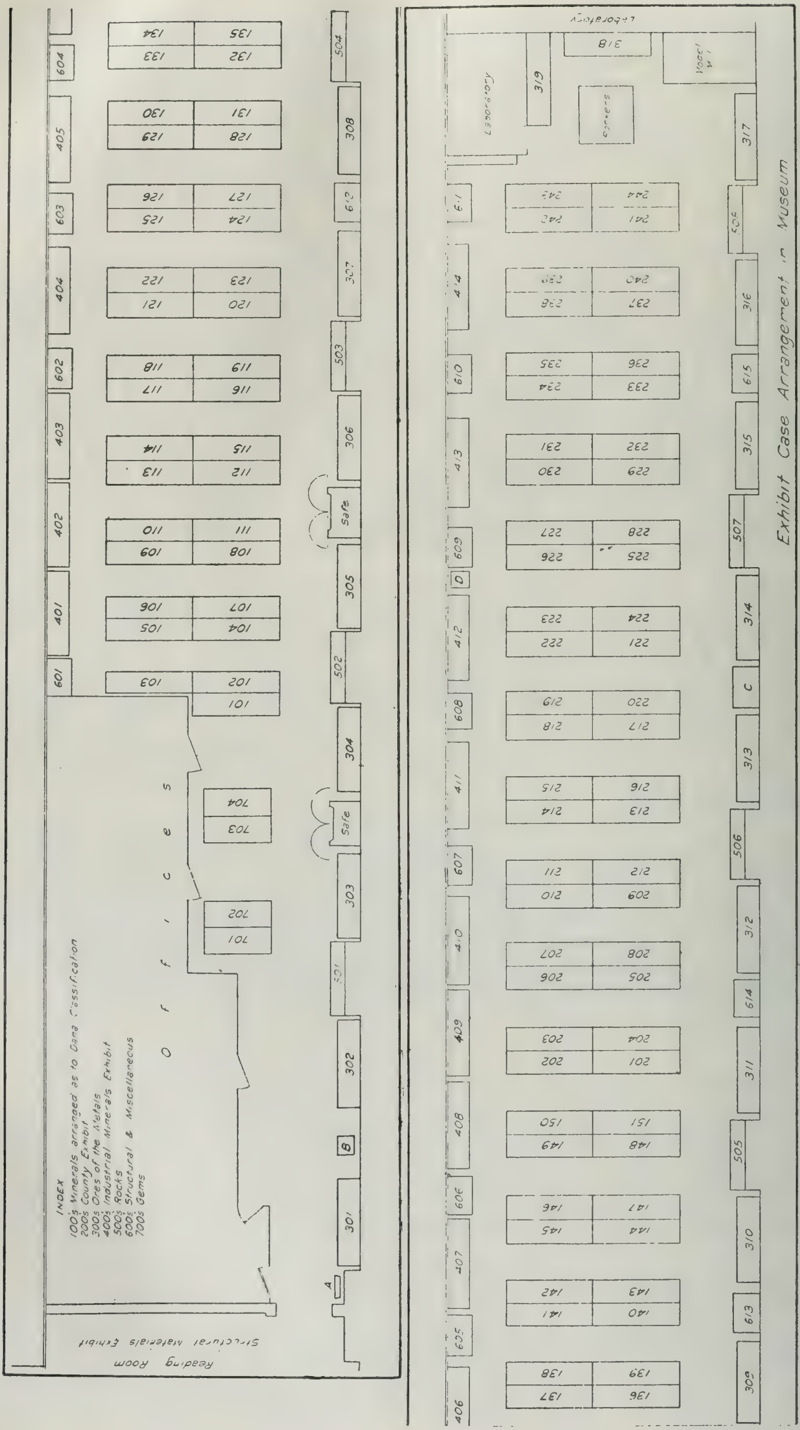
INDEX
100s Minerals arranged as to Dana Classification
200s County Exhibit
300s Ores of the Metals
400s Industrial Minerals Exhibit
500s Rocks
600s Structural & Miscellaneous
700s Gems
Offices
Safe
Safe
Structural Materials Exhibit
Reading Room
Laboratory
Laboratory

Exhibit Case Arrangement in Museum

INDEX OF MINERAL COLLECTION IN THE MUSEUM

	Case No.
MINERAL EXHIBIT ARRANGED AS TO DANA CLASSIFICATION	101–151
Native elements	101–103
Sulphides, Selenides, Tellurides, Arsenides, Antimonides	104–109
Sulpho-salts	110–111
Haloides	112–113
Oxides	114–119
Oxygen-salts	120–150
Carbonates	120–123
Silicates, Titanates	124–139
Niobates, Tantalates	140
Phosphates, Arsenates, Vanadates, Antimonates	141–146
Borates, Uranates	146
Sulphates, Chromates, Tellurates	147–150
Tungstates, Molybdates	150
Hydrocarbons	151
MINERAL EXHIBIT ARRANGED BY COUNTIES IN CALIFORNIA	201–239
Alameda	201
Alpine	201
Amador	202
Butte	203
Calaveras	204
Colusa	203
Contra Costa	205
Del Norte	205
El Dorado	206
Fresno	207
Glenn	207
Humboldt	208
Imperial	208
Inyo	209–210
Kern	211
Kings	212
Lake	212
Lassen	213
Los Angeles	213
Madera	214
Marin	214
Mariposa	215
Mendocino	216
Merced	216
Modoc	217
Mono	217
Monterey	218
Napa	218
Nevada	219–220
Orange	221
Placer	221
Plumas	222
Riverside	223
Sacramento	224
San Benito	224
San Bernardino	225–226
San Diego	227
San Francisco	227
San Joaquin	228
San Luis Obispo	228
San Mateo	229
Santa Barbara	229
Santa Clara	230
Santa Cruz	230
Shasta	231
Sierra	232
Siskiyou	233
Solano	232
Sonoma	234
Stanislaus	234
Sutter	235
Tehama	235
Trinity	236
Tulare	237
Tuolumne	238
Ventura	237
Yolo	239
Yuba	239

	Case No.
MINERAL EXHIBITS ARRANGED BY STATES AND FOREIGN COUNTRIES	240–243, 315–317
Oregon	240
Washington	240
Nevada	241
Montana	242
South Dakota	242
Idaho	242
Philippine Islands, Africa, Australia, New Zealand	243
Canada, Alaska	244
Arizona	315
New Mexico	315
Colorado	316
Utah	316
Mexico, Central America, South America	317
EXHIBIT ARRANGED AS TO THE ORES OF THE METALS	301–314
Aluminum	301
Antimony	301
Arsenic	301
Bismuth	301
Cadmium	301
Cerium	301
Cobalt	301
Chromium	302
Copper	302–303
Gold	304–305
Iron	306
Lead	307
Manganese	308
Molybdenum	308
Nickel	308
Platinum	308
Quicksilver (Mercury)	309
Silver	310–311
Tin	312
Titanium	312
Tungsten	313
Uranium	313
Zinc	314
INDUSTRIAL MINERAL EXHIBITS	401–414
School Collection	401
Abrasives	401
Asbestos	402
Barium Minerals	402
Clays	403
Coal	404
Graphite	405
Gypsum	405
Limestone	405
Feldspar	406
Fluorspar	406
Lithium	407
Magnesite	407
Mica	407
Mineral Paints	408
Phosphates	408
Salines	409–411
Borates	409
Salt	410
Soda	411
Silica	412
Soapstone and Talc	413
Strontium	414
Sulphur	414
ROCKS	501–508
Igneous Rocks	501–503
Plutonic (Granitic texture)	501
Volcanic (fine grained and felsitic texture)	502
Volcanic, extrusive lavas and glasses	503
Sedimentary Rocks	504
Metamorphic Rocks	505–506
Mother Lode Rocks (collected by W. H. Storms, see Bulletin No. 18)	507–508
Miscellaneous and Structural Exhibits	601–615
Gems and Gold	701–704

Index to Museum, Alphabetically Arranged According to Minerals and Rocks

	Case No.
Abalone Pearls	703
Acanthite	106
Acmite	126
Actinolite	127, 225–226

	Case No.
Adamite	142
Adularia	124
Aegirite	126
Aenigmatite	127
Aeschynite	140
Agalmatolite	135
Agate	114, 412, 703
Aglaite	126
Aguilarite	106
Aikinite	110
Alabandite	106
Alabaster	605
Albite	125
Albertite	151
Alexandrite	117
Alexandrolite	139
Algerite	130
Algodonite	105
Allanite	132, 501
Allemontite	101
Allochroite	129
Almandite	129
Alum	149, 315, 506
Alum and Sulphur, Native	506
Alumina Sulphate	502
Aluminum Ore	301
Alumocalcite	115
Alunite	150
Alunogen	149, 209–210
Amalgam	102
Amazonstone	124
Amblygonite	142, 227
Ambrite	151
Amethyst	114, 412, 702
Amethyst Matrix	702
Amianthus	127, 402
Amphibolite	508
Analcite	134
Analcite Diabase	501
Anamesite	502
Anapaite	143
Anatase	118
Andalusite	131, 214, 613
Andalusite Schist	506
Andesite	212, 234, 502
Anglesite	147, 307, 317
Anhydrite	147
Anhydrite, White	223
Ankerite	120
Ankerite and Mariposite	506
Annabergite	143
Annite	136
Anorthite	125
Anthophyllite	127
Antimony	101, 211, 301, 609
Antimony Ore	209–211, 213, 224, 228, 230, 301, 609
Apatite	141, 408
Apthitalite	147
Aplite	501
Aplome	129
Apophyllite	134
Aquacreptite	140
Aquamarine	127 ,701
Aragonite	121, 228, 234, 503, 605, 607, 608, 405
Aragotite	151, 602
Arfvedsonite	127
Argentiferous Galena	613
Argentite	105, 310, 317
Argillaceous Schist	506
Argillite	506
Argyrodite	111
Arquerite	102
Arsenic	101, 201, 301
Arsenic Ores	301
Arsenolite	116
Arsenopyrite	109, 208, 227, 301, 401, 612
Asbeferrite	127
Asbestos	127, 138, 203–204, 207, 209–210, 215, 218, 221–223, 232, 236, 239, 401–402, 601
Asbolite	119, 237, 301
Asparagus Stone	141
Asphalt	151, 404
Asphaltum	151, 213, 228, 229, 404
Astrophyllite	140
Atacamite	113

	Case No.
Auerlite	130
Augite	126
Augite Andesite	502
Augite Dike	507
Aurichalcite	123
Auriferous Gravel	612
Automolite	117
Autunite	145
Aventurine	125
Awaruite	103
Axinite	132
Azurite	123, 217, 225, 226, 243, 303, 401
Azurite and Malachite (Gem)	702
Babingtonite	126
Barcenite	145
Barite	147, 204–206, 209–210, 212, 213, 215, 217, 221, 224–226, 229–231, 233, 236, 315, 401, 402, 612, 614
Barrandite	143
Barytocalcite	122
Basalt	401, 502
Bastnasite	122
Bauxite	119, 223, 301
Bayldonite	144
Beegerite	111
Bementite	140
Benitoite	140, 224 (first safe)
Benjaminite	110
Bentonite	403
Beraunite	144
Bernardinite	151
Berthierite	110
Berthierine	137
Beryl	128, 206, 223, 501, 506, 701
Beryl, Blue	501
Beryl, Pink (Gem)	701
Beryllonite	141
Berzelianite	106
Berzeliite	141
Bieberite	149
Bindheimite	145
Binnite	111
Biotite	136
Biotite Gabbro	501
Biotite Gneiss	506
Bismite	116, 301
Bismuth	101, 209–210, 301, 316
Bismuth Ores	301
Bismuthinite	104, 207, 301, 317
Busmutite	123, 301
Bismutospharite	122
Bitumen	151, 404
Bituminous Earth	214
Bituminous Sandstone	218, 230
Bituminous Shale	151, 225–226
Bixbyite	117
Blődite	149
Bloodstone	209–210, 702
Blue Corundum	613
Boghead Schist	151
Bole	202
Boleite	113
Boracic Acid	409
Boracite	146, 409
Borate of Lime (see Colemanite)	146
Borate of Soda	409
Borax	209–210, 409
Borax Crystals	409
Borax Rock	225–226
Borickite	144
Bornite	107, 202, 206–207, 222, 303, 401, 614
Botryogen	150
Botryolite	132
Botryolite Calcite	503
Boulangerite	110
Bournonite	110
Bowenite	138
Brackebuschite	142
Braunite	126
Bravaistite	140
Breccia	221
Breithauptite	107
Brewsterite	134
Brickbat Ore	217
Brochantite	148

	Case No.
Bromyrite	112
Bronzite	125
Brookite	118
Brucite	119, 407
Building Stone	504, 601, 603–604
Burnt Ochre	408
Cacoclasite	130
Cacoxenite	144
Cadmium Ore	301
Calamine	133, 209–210, 225–226, 314
Calaverite	704
Calcareous Tufa	504
Calcite	120, 201, 203, 206, 208–210, 217, 221–223, 227–230, 233, 236, 238, 243, 309, 401, 405, 414, 503, 504, 602, 610, 614
Calcium Carbonate (see Calcite, Aragonite and Limestone)	411
Calco-Zincite	314
Caledonite	148
Californite	130, 233, 702, 703
Calomel	112
Cambrian Sandstone	504
Campylite	142
Camsellite	133
Cancrinite	128
Carbonized Wood	236
Carnotite	145, 313
Carpholite	133
Cassiterite	118, 312, 317
Castorite	124
Caswellite	137
Cat's Eye	702
Celestine	414
Celestite	147, 217, 225–226, 414
Cement Rock	232
Cemented Conglomerate	504
Cerargyrite (Horn Silver)	112, 310, 315 (Safe 2)
Cerite	133
Cerium Ore	301
Cerussite	122, 307
Cervantite	116
Chabazite	134
Chalcanthite	149, 204
Chalcedony	114, 201, 225–226, 228, 401, 412, 702–730
Chalcocite	106, 208, 227, 237, 303, 315, 614
Chalcophanite	119, 308, 314
Chalcophyllite	144
Chalcopyrite	108, 202, 204, 207, 209–210, 218, 222, 227, 231, 236, 303, 401, 614
Chalcosiderite	144
Chalcostibite	110
Chalcotrichite	116
Chalybite	121
Chenevixite	144
Chert and Limestone	504
Chessylite	303
Chiastolite	131
Chiastolite	506–508
Childrenite	144
Chloanthite	108
Chlorastrolite	135
Chloride of Silver	317
Chlorite Diorite	507
Chlorite Quartz Schist	506
Chlorite Schist	506
Chlorite Younger Gneiss	506
Chloritoid	136
Chloropal	140, 217
Chlorophaeite	137
Chondrodite	133
Chromite	117, 201–208, 212, 214–216, 218–219, 221, 227, 229–234, 236–238, 243, 302, 401
Chrysoberyl	139, 209–210, 227, 303, 702
Chrysolite	129, 702
Chrysoprase	114, 237, 702
Chrysotile	138, 402
Cimolite	139
Cinnabar	107, 201, 203, 206–207, 209–212, 215, 216, 218, 224, 228–232, 234, 236, 309, 315, 316, 401, 612
Clam Shell Marl	504
Clarkite	146
Claudetite	116
Clausthalite	106
Clay	139, 201–202, 204–207, 209–210, 212, 217–218, 221, 223–227, 229, 231, 233–236, 403, 613
Clay Slate	131
Cleavelandite	125

	Case No.
Clinochlore	137
Clinoclasite	142
Coal	151, 201, 205, 207, 211, 213, 216, 224, 227, 230, 231, 233–238, 404, 604, 609
Cobalt Ore	143, 301, 308, 323
Cobaltite	109
Coke	404
Colemanite	146, 209–210, 225–226, 237, 409, 612
Colophonite	129
Coloadoite	106
Columbite	140
Concentrate	304, 620
Condurrite	105
Conglomerate	507–508
Conichalcite	144
Connarite-Konarit	139
Connellite	148
Cookeite	136
Copiapite	150
Copper (Native)	102, 302, 609, 202, 203, 205–219, 221–228, 230–231, 233–238, 243, 315–317, 612
Copper Ore	302–303, 613, 614
Coquimbite	149
Coral Limestone	504
Corundum	116, 613
Corynite	109
Cosalite	110
Covellite	107, 204
Crednerite	117
Crestmoreite	134
Cristobalite	612
Crocidolite	127
Crocoite	148
Cronstedtite	137
Cryolite	113
Cryophyllite	136
Crystalline Rock	508
Cubanite	108
Cummingtonite	127
Cuprite	116, 209, 219, 231, 303
Cupro-Descloizite	142
Cupro-Plumbite	105
Cupro-Scheelite	150, 313
Curtisite	151
Cut Crystals	603
Cyanite	131, 613
Cylindrite	111
Cymatolite	126
Cyprine	130
Cyrtolite	130
Dacite	502
Damitatoid Garnet	129
Damourite	135
Danaite	109
Danburite	131
Datolite	132, 227
Dawsonite	123
Dechenite	142
Delessite	137
Dendrites	211, 502–504
Descloizite	142, 313
Deweylite	138
Dibantite	137
Diabase	501, 507–508
Diabase Conglomerate	507
Diabase Porphyrites	507–508
Diabasic Rock	507
Diadochite	145
Diallage	501
Diamond	101, 703 (1st safe)
Diaspore	119, 301
Diatomaceous Earth	115, 205, 213, 218, 229, 401, 412
Dihydrite	142
Dike Rock	507–508
Diopside	126, 223
Dioptase	130, 703
Diorite	501, 507, 508, 611
Diorite Porphyrites	507–508
Diorite Schist	508
Dolerite	502
Dolomite	120, 201, 203, 209, 210, 218, 221, 406, 605, 613
Domeykite	105
Dufrenite	143
Dufrenoysite	110
Dumortierite	133, 208, 223, 613

	Case No.
Dunite	501
Durdensite	150
Durangite	142
Dysanalyte	140
Dyscrasite	105
Dysluite	117
Eclogite	506
Edenite	127
Ekebergite	130
Elaeolite	128
Elaeolite Syenite	501
Electrum	102, 243, 304
Embolite	110, 243, 310
Emerald	128
Emplectite	110
Enargite	111, 201, 303
Endlichite	142
Enstatite	125
Epiboulangerite	111
Epidote	132, 211
Epsomite	149
Erinite	142
Erubescite	107, 303
Eruptive Rock	503, 507
Erythrite	143, 301
Essonite	129
Euchroite	144
Eudialyte	127
Eudidymite	124
Eulytite	128
Euxenite	140
Evansite	144
Faujasite	134
Fault Breccia	504
Feldspar (See Orthoclase, etc.)	124, 125, 215, 218, 222, 223, 406
Feldspathic Rock	507
Felsite	502, 507
Felsite Dike Rock	508
Felsite Schist	508
Ferberite	150, 313
Fergusonite	140
Ferruginous Earth	408
Ferruginous Clay	232
Fibroferrite	150
Fibrolite	131, 507
Fiorite	115, 412
Fire Clay	403, 504, 613
Flint	114
Flint Pebbles	412
Fluorite	113, 406, 702
Fluorspar (See Fluorite)	113, 225–226, 406
Forsterite	129
Fossil Coral	504
Fossil Wood	228
Fossils	Reading Room
Fowlerite	126
Franklinite	117, 308, 314
Freestone	610
Freibergite	310
Freieslebenite	110
French Chalk	413
Fuchsite	135, 221
Fullers Earth	232, 403
Gabbro	501
Gabbro Diorite	501
Gadolinite	132
Galena	105, 209–210, 213, 237, 316, 401, 307
Galenobismutite	110
Gastaldtite	127
Garnet	129, 202–204, 211, 214, 215, 218, 223, 226, 237, 401
Garnet Schist	506
Garnierite and Genthite	138, 308
Gay-Lussite	123
Genthite	138, 308
Gersdorffite	109
Gibbsite	119
Gieseckite	135
Gigantolite	135
Gillespite	136
Gilsonite	151
Glagerite	139
Glass Sand	412
Glauberite	147
Glauber Salt	209–210, 411
Glaucodot	109

	Case No.
Glauconite	139
Glaucophane	127
Gmelinite	134
Gneiss	506–508
Gold	101, 102, 304, 305, 704
Gold Ores	101, 102, 201–204, 206, 209–219, 221–223, 225–227, 230–233, 236–239, 243, 304, 315, 316, 317, 401, 609, 704, 614
Goshenite	128
Gothite	119, 306
Grahamite	151
Grammatite	127
Granite	401, 406, 501, 507, 611
Granite, Glaciated	504
Granodiorite	501, 504, 611
Granodiorite with Epidote	501
Graphite	101, 207–208, 213, 216, 225–227, 234–235, 237–238, 405, 610
Granulyte	124
Grauwacke	507
Gray-Younger Gneiss	506
Greenockite	107, 217, 301
Greenovite	140
Grossularite	129, 209–210
Grunauite	107
Guadalcazarite	106
Guarinite	140
Guitermanite	110
Gummite	146
Gypsite	504
Gypsum	148, 205, 207–210, 213, 216, 223–229, 234, 237, 315, 405, 504
Gyrolite	134
Hagemannite	113
Halleflinte	406
Halite	112, 410–411
Halloysite	139, 227, 237, 403
Halotrichite	149
Hancockite	132
Hanging Wall	507
Hanksite	148
Hard Blue Ground	602
Harmotome	134
Hauerite	108
Hausmannite	117
Hauynite	128
Haydenite	134
Helvite	128
Hematite	117, 202–203, 208, 212–213, 216, 221, 223, 231, 236, 317, 306, 401, 408
Henwoodite	144
Herrengrundite	150
Herschelite	134
Hesingerite	140
Hessite	105, 305
Hetaerolite	117
Heterogenite	119
Heteromorphite	310
Heulandite	134
Hewittite	145, 313
Hiddenite	126
Hiortdahlite	126
Hohmanite	151
Hornblende	127, 401
Hornblende Andosite	502
Hornblende Porphyry	501
Hornblende Rock	507
Hornblende Schist	506
Hornblendic Gneiss	508
Hornite	614
Hornstone	412
Houghite	119
Howlite	146
Huantajayite	112
Hubnerite	150, 225–226, 313
Humboldtilite	130
Hyacinth	703
Hyalite	115, 212, 412, 702
Hydroboracite	146
Hydro-Cuprite	116
Hydromagnesite	123, 407, 201, 214, 227, 228, 229
Hydrotalcite	119
Hydro-Zincite	314
Hypersthene	126
Hypesthene Gabbro	501
Iceland Spar	120, 208, 217, 225, 226, 405, 702
Iddingsite	129
Ilmenite	117, 215

	Case No.
Ilsemannite	116
Indianite	139
Indicolite	703
Inyoite	146
Iodyrite	112
Iolite	128
Iridium	See 1st Safe
Iridosmine	See 1st Safe
Iron	103
Iron Ore	203–207, 209, 210, 212–215, 217–219, 222–228, 231, 234, 235, 237, 239, 306, 408
Iron Oxide	408
Jacobsite	117
Jade	126, 127
Jadeite	126
Jamesonite	110
Jarosite	150
Jasper	114, 214, 225–226, 412, 602, 701, 703
Jefferisite	137
Jeffersonite	126
Jet	404
Johannite	150
Jordanite	111
Josephinite	103
Kammererite	137
Kaolin	211, 219, 225, 226, 403, 613
Kaolinite	139, 403
Keatingite	126
Kermesite	109
Kernite	146, 211, 409
Kersantite	501
Kidney Ore	117
Killinite	126
Kimberlite	501
Kjerulfine	142
Knebelite	126
Knoxvillite	150
Kobellite	110
Koppite	140
Kotschubeite	137
Krablite	124
Kramerite	146, 211
Krauerite	141
Krennerite	304
Krestelite	310
Krohnkite	149
Kunzite	701, 703
Kyanite	613
Labradorite	125, 406, 702
Lapis Lazuli	128, 702, 703
Laterite	301
Laumontite	134
Laurionite	113
Lava	502, 503
Lava and Olivine	503
Lawsonite	133
Lazulite	143, 227
Lead	102
Lead Ore	203, 211, 213, 214, 221, 225, 226, 237, 307, 612
Ledererite	134
Lehrbachite	106
Lepidolite	136, 401, 407
Leuchtenbergite	137
Leucophyre Rock	502
Leucite	125
Lherzolite	501
Libethenite	142
Liebigite	123
Lignite (see Coal)	151, 201,227, 404, 601
Lillianite	110
Limestone	201–202, 204–205, 207–213, 216, 218, 221–227, 229–231, 234, 237, 238, 405, 504, 507, 508
Limonite	119, 202–204, 215, 219, 222, 228, 231, 237, 306, 401, 408, 613, 614
Linarite	148
Linnaeite	108
Liparite	502
Liroconite	144
Liskeardite	144
Lithiophilite	141
Litho-Carbon	151
Lithographic Stone	405
Lithomarge	204, 213, 221
Livingstonite	110
Lodestone	117, 306

	Case No.
Löllingite	109
Magnesite	120, 201, 211, 212, 218, 221, 224, 229, 230, 234, 235, 237, 238, 401, 407, 507, 614
Magnesium Silicate	227
Magnetite	117, 202–204, 206, 214, 216, 224, 225, 226, 229, 231, 232, 235, 236–237, 306, 401, 506
Malachite	122, 201, 237, 303, 401, 702, 703
Malacolite	126, 507
Malacon	130
Manganese Ore	201, 204–205, 207, 212, 213, 214, 215, 216, 218, 221, 222, 224–230, 234, 308, 401
Manganite	119, 308
Marble	202–204, 215, 219, 225–227, 230, 508, 601, 602, 604, 606–608, 610
Marble Granules	602
Marcasite	109, 315
Margarite	136
Margarodite	135
Mariposite	135, 509
Marl (Lime)	230, 504, 614
Marmolite	138
Martite	117
Massicot	116
Matlockite	113
Meerschaum	139
Melaconite	116, 303
Melanophlogite	115
Melaphyre Rock	502
Melanite	129
Melanterite	149
Melilite	130
Meliphanite	128
Menaccanite	117, 312
Mendipite	113
Mendozite	149
Meneghinite	111
Mercury (also Quicksilver)	102, 309
Mesitite	120
Mesolite	135
Mesotype	135
Metacinnabarite	106, 212, 218, 224, 239, 309
Metal	Reading Room
Metamorphic Rock	508
Metavoltine	150
Meteoric Iron	103
Mica	135, 211, 213, 407
Mica Andesite	502
Mica Felsite	508
Mica Gneiss	506
Mica Schist	506–507
Micaceous Talc-Schist	506
Microcline	124, 406
Milarite	124
Millerite	107, 308
Mimetite	142
Mineral Paint	203, 234, 408, 614
Minium	117, 307
Mirabilite	148
Mispickel	109
Mixite	145
Mohawkite	105
Molybdenite	104, 207, 209–210, 214, 217, 218, 219, 221–223, 227, 231, 236, 237, 308, 316
Molybdenum Ore	308
Molybdite	116, 209, 210
Monazite	141, 301
Monticellite	129
Montmorillonite	139, 209–210, 225–226, 234, 403
Montroydite	117
Moonstone	702–703
Mordenite	134
Morenosite	149
Morganite (Pink Beryl)	703
Moss Agate	114, 702
Moss Opal	702
Moss Quartz	703
Mountain Leather	127, 230
Mullicite	143
Muscovite	135, 401, 407
Muscovite-Biotite	501
Muscovite, Rose	135
Mussite	126
Myrickite	225, 702
Nadorite	145
Nagyagite	109

	Case No.
Napalite	151, 218
Natrolite	135
Nemalite	119
Nephelite	128, 501
Nepheline Syenite	501
Neptunite	140
Nesquehonite	123
Niccolite	107
Nickel Ore	301, 308, 609
Nigrine	118
Niter	145, 411
Nitrate Bearing Rock	209–210, 411
Nitrate of Soda	411
Nontronite	137
Norite	501
Northupite	122
Noselite	128
Noumeaite	138
Novaculite	401
Obsidian	217, 218, 401, 503
Ochre	206, 229, 234, 408
Ochrolite	145
Octahedrite	118
Oil—Refined	615
Oil Sand	504
Oil Shale	151–229
Oligoclase	125, 406
Olivenite	142
Olivine	129
Olivine Rock	508
Onyx, Mexican	605
Opal	115, 225–227, 412, 702, 703
Opal in Matrix	702, 703
Opalized Wood	702
Orbicular Diorite	501, 701
Orbicular Jasper	703
Orpiment	104, 201, 212
Orthite	132
Orthoclase	124, 207, 211, 227, 401, 406
Ottrelite	136
Ouvarovite	129
Ozocerite	151
Pachnolite	113
Pagodite	135
Palladium	See 1st Safe
Pandermite	146, 409
Partzite	116
Patronite	105, 313
Pearl Sinter	115, 412
Peat	151, 404
Pebbles	504
Pectolite	126
Pegmatite	501
Penninite	137
Peridolite	501
Peridot	701
Peristerite	125
Perlite	503
Perovskite	140
Perthite	124, 406
Pescadero Beach Stones	702
Petalite	124
Petoskey Stone	703
Petrified Wood	115, 613
Petzite	105, 304, 310
Phacolite	134
Pharmacolite	143
Pharmacosiderite	144
Phenacite	129
Philadelphite	137
Phillipsite	134
Phlogonite	136, 407
Phonolite	502
Phosgenite	122
Phosphate of Lime	408
Phosphate Nodules	408
Phosphate Rock	408
Phosphatic Earth	408
Phosphorite	141, 408
Phyllite or Hydro Mica Schist	506
Pickeringite	149
Picrolite	138, 203, 506
Picromerite	149
Piece of Ancient Roman Pavement	605
Piedmontite	132

	Case No.
Pilinite	140, 503
Pimelite	138
Pinquite	137
Pisolite	504
Pitchstone	406, 503
Plagionite	110
Platinum	1st safe, 102
Platinum Ore	308
Plattnerite	118
Plumbo-Jarosite	308
Polianite	118
Pollucite	125
Polybasite	111, 310
Polycrase	140
Polyhalite	149, 411
Porcellophite	138
Porphyry	316, 501
Potash	615
Potash Feldspar	124
Powellite	150
Prase-Opal	412
Prehnite	132
Priceite	146–409
Probertite	146, 211
Prochlorite	137
Proustite	111
Psilomelane	119, 213, 227, 301, 308
Pucherite	141
Pumice	208, 218, 233, 303, 401
Pycnite	131
Pyrargyrite	110, 310, 317, 613
Pyrite	108, 201–202, 204, 212, 215, 231, 315, 401, 614
Pyrocenite	501
Pyrolusite	204, 219, 225–227, 234, 238, 308
Pyromorphite	141
Pyrope	129
Pyrophyllite	139, 215
Pyrosmalite	130
Pyroxene	126
Pyroxene Andesite	502
Pyroxenite with Platinum	308
Pyrrhotite	107, 237, 306, 314, 401
Quartz	114, 201, 221, 226–227, 239, 310, 401, 412, 610, 701, 702
Quartz Basalt	502
Quartz Mica-Felsite	502
Quartz Porphyry	501, 508
Quartz Rhyolite Porphyry	501
Quartzite	508
Quicksilver (Mercury)	101, 102, 309
Quicksilver Ore	203, 205, 212, 215, 224, 227, 228, 232, 239, 309
Quisqueite	101
Ralstonite	113
Rammelsbergite	109
Randite	123
Raselite	143
Rasorite	146
Realgar	104, 201, 212, 234, 301, 316, 612
Rectorite	139
Redruthite	106
Resinite	115
Rhodochromite	137
Rhodochrosite	121, 308
Rhodonite	126, 221, 238, 308
Rhyolite	228, 502
Richterite	127
Ricolite	138
Riebeckite	127
Rittingerite	111
Roblin Ware	403
Rock Crystal Sphere	702
Rock Formation	601
Rock Soap	224
Romeite	145
Roscoelite	136, 303
Roselite	143
Rose Muscovite	135
Rose Quartz	114, 222, 237, 412, 610
Rose Stone	702
Rosin Tin	312
Rottisite	138
Rubellite	133, 401
Ruby	701
Ruby Spinel	218
Rutile	118, 312

	Case No.
Rutillated Quartz	702
Sal Soda	411
Salt (Halite)	112, 218, 410, 603
Samarskite	140
Sanbornite	124
Sand Concretion	504
Sandstone	401, 504, 507, 601, 604
Sandstone and Vanadium	313
Sanidine Rhyolite	502
Sapphire	116, 701–702
Sapphire, Cross	703
Sarcolite	130
Sardonyx	114
Sarkinite	142
Sartorite	110
Satin Spar (Gypsum)	148
Saxonite	501
Scapolite	130
Scarabs	702
Scheelite	150, 209–210, 232, 238, 313, 316
Schirmerite	110
Schist	508
Schorlomite	129
Schröckingerite	123
Schrotterite	139
Schwartzembergite	113
Scolecite	135
Scoria	503
Scorodite	143, 301, 612
Selbite	310
Selenite	148, 203, 209–210, 212, 215, 228, 229, 234, 237, 405, 414, 601
Selen-Sulphur	101
Semi Opal	412
Senarmontite	116, 301
Sepiolite	139
Sericite	135
Sericite Mica	135
Sericite Schist	139, 506
Serpentine	138, 221, 301, 605, 608
Serpentine, Schist	506
Serpentine, Silicified	506
Shale	201, 234, 401, 504, 508
Shale, Kaolinized	504
Siderite	121, 306
Siegenite	108
Silica Sand	412
Silicate of Thorium	130
Silicified Wood	114, 412
Sillimanite	209, 210, 313, 613
Silver	101, 102, 310
Silver Ore	201, 206–207, 209–211, 213–215, 217–218, 221–222, 225–227, 229, 231, 233, 235, 237, 238, 243, 310, 311, 315, 316, 317, 612, 614
Silver Talc	413
Skutterudite	109
Slate	206, 216, 238, 506–508, 610
Smaltite	108, 301, 612
Smithsonite	121, 301, 314
Smoky Quartz	124
Soapstone (Talc Stealite)	203, 206, 213, 238
Soda	209, 210, 411
Soda, Crude	411
Sodalite	128
Soda Niter	145
Soda Sulphate	411
Spadaite	139
Spessartite	129
Sphaero-Stillbite	134
Sphalerite	106, 202, 207, 213–214, 215, 217, 221, 229, 231, 237–238, 314
Spinel	117
Spodumene	126
Spurrite	122
Stalactite	504, 601
Stannite	108
Staurolite	133
Steatite (Talc Soapstone)	139, 207, 209–210, 214, 218, 221, 227, 231, 237, 238, 413
Steinmonnite—a form of gelena with As and Sb	105
Stephanite	111, 310–311
Stetefeldtite	116
Stibianite	116
Stibiconite	116
Stibiotantalite	140
Stibnite	104, 211, 213, 224–226, 230, 237, 301, 317, 401, 602
Stilbite	134
Stilpnomelane	137

	Case No.
Stolzite	150, 313
Stone (Artificial)	613
Straw Agate	702
Strengite	143
Strigovite	137
Stromeyerite	106
Strontianite	122, 225, 226, 414
Strontiano-Calcite	216
Struvite	143
Stylotypite	110
Sulphate of Copper	506
Sulphur	101, 203, 209–213, 234, 237, 401, 414, 601
Sussexite	146
Syenite	501, 507–508
Syenite Gneiss	507
Syenite Hornblende	611
Sylvanite	109, 315
Sylvite	112, 411
Syngenite	149
Talc (Steatite, Soapstone)	139, 204, 209–210, 213, 215, 219, 223, 225–226, 230, 233, 235, 236, 401, 413, 507
Talc Schist	506, 507
Talc Serpentine Rock	506
Talc Slate	238, 506
Talcose Schist	506, 508
Tantalite	140
Tarnowitzite	121
Tasmanite	151
Telluride Ore	704
Tellurium	101
Tennantite	111, 303
Tenorite	116
Terrazzo	602
Tetradymite	104
Tetrahedrite	111, 303
Thaumasite	139
Thenardite	147, 225–226, 411, 504
Theralite	501
Thinolite	120, 217
Thomasonite	135
Thulite	132
Tiemannite	106
Tilasite	142
Tiger Eye	702, 703
Tin	102, 312
Tin Ore	223, 312, 609
Tincal	146, 409
Tin Stones	312
Titanite	140, 312
Titanium Ore	312
Topaz	131, 701, 703
Topaz, Hyacinth	703
Torbernite	145, 313
Tourmaline	133, 217, 223, 701
Trap, Basaltic	502
Trap, Thomsonite	502
Travertine	127, 605, 608
Tremolite	127
Tridymite	115
Triphylite	141
Triplite	142
Tritomite	128
Troilite	107
Trona	123, 411
Troostite	129
Tschermigite	149
Tufa	227
Tungstenite	105
Tungsten Ore	225, 226, 313
Turgite	119
Turquoise	144, 702
Turquois Matrix	702, 703
Tyrolite	144
Ulexite	146, 209–211, 409
Ullmannite	109
Umber	408
Uralite	127, 612
Uraninite	146
Uranium Ochre	146
Uranium Ore	313
Uranophane	139
Uranothorite	130
Utahite	150
Uvanite	145
Uvarovite	129

Case No.

Vanadinite 142, 211, 313, 613
Vanadium and Uranium Ore 313
Vanuxemite 133
Variscite 143, 703
Vasicular Basalt 218, 503, 613
Vein Matter 508
Venetian Red 408
Vesbine 137
Vesuvianite 130, 203, 233, 702, 703
Violan 126
Vitrophyre 503
Vivianite 143, 201, 213, 214
Voglite 123
Volcanic Ash 204, 227, 235, 401, 503
Volcanic Glass 503
Volcanic Lapilli 503
Volcanic Rock 502
Volcanic Tufa 212, 503
Volsenite 146
Wad 119, 237, 308
Wall Rock 301, 508
Walpurgite 145
Wardite 144
Warwickite 146
Wavellite 144
Wernerite 130
White Steatite 413
White-Younger Gneiss 506
Whiting 408
Whitneyite 105
Willemite 129, 314
Witherite 122
Wittichenite 110
Wolframite 150, 211, 215, 225–226, 313, 317
Wollastonite 126, 223, 614
Wollongonite 151
Wood Opal 412
Wood, Petrified 115
Wood, Silicified 114
Woodwardite 149
Worm Tubes 504
Wulfenite 150, 308, 613
Wurtzilite 151
Wurtzite 107
Xanthoconite 111
Xanthophyllite 136
Xanthosiderite 119
Yellow Ground 602
Zaratite 123
Zinc Blende 219
Zincite 314
Zinc Ore 314
Zinkenite 110
Zippeite 150
Zircon 130, 701
Zoisite 132
Zorgite 106
Zunyite 128

LABORATORY

FRANK SANBORN, Mineral Technologist

The laboratory of the Division of Mines is maintained for the purpose of identifying minerals and making qualitative analyses of rocks. These determinations and analyses are made without cost to those who seek the services of this state department. Ordinarily, a small sample weighing not over half a pound, in the lump form if possible, should be submitted with a letter stating what particular tests are desired, if there is a special reason for sending the material. Not more than three samples should be sent at one time, nor is it necessary to send more than one. Information regarding the size of the deposit and its proximity to rail transportation is useful in determining the possible value of a mineral body.

When requested, assistance in finding a market for a mineral will be given. When such help is desired, a small representative sample of the material for which a market is sought should accompany the request. The division is sometimes able to send a very small sample of a particular mineral for comparative purposes to any earnest prospector. Prospecting and exploitation of the state's mineral wealth increases as the state becomes more thickly populated. Each year new ocurrences of some mineral in the state are reported and occasionally a new mineral species is found. New uses for a mineral are frequently found, and as a result stimulus is given to searching for that particular substance.

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HERBERT A. FRANKE, Librarian

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It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, CALIFORNIA JORRNAL OF MINES AND GEOLOGY contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the state are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

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Government, National

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  Bulletins:
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  Professional Papers:
    179 —Origin of the Copper Deposits of the Ducktown type in the Southern Appalachian Region. By C. S. Ross.
    185B—Paleozoic Formations of the Mosquito Range, Colorado. By J. H. Johnson.
    185C—The Recognizable Species of the Green River Flora. By R. W. Brown.
    185E—Miocene Plants from Idaho. By E. W. Berry.
  Water Supply Papers:
    660—Artesian Water in Sommervell Co., Texas.
  Public Works Administration:
    P. W. 29021—Preliminary Report on Gold Deposits in North Carolina and South Carolina. By J. T. Pardee.
U. S. Bureau of Mines:
  Bulletins:
    382—Permissible Coal-Cutting Equipment. By Ilsley, Brunot & Freeman.
  Economic Papers:
    17—Arsenic. By Tyler & Petar.
  Technical Papers:
    561—Mechanical Equipment Used in the Drilling and Production of Oil and Gas Wells in Oklahoma City Field. By G. Wade.

Information Circulars:

6788—Placer Mining in the Western United States Part III. Dredging and other Forms of Mechanical Handling of Gravel and Drift Mining. By E. D. Gardner and C. H. Johnson.
6814—Sand and Gravel Excavation: Part 2: Power Scraper, Slackline Cableway Excavator, and Hydraulic Giant. By J. R. Thoenen.
6815—Mining Operations at the Property of the Britannia Mining and Smelting Co., Ltd., Britannia Beach, British Columbia. By C. V. Brennan.
6816—Waste Filling of Stopes. By Chas. F. Jackson.
6817—Asbestos—General Information. By Oliver Bowles.
6818—List of Permissible Mine Equipment. By L. C. Ilsley.
6819—Coal-Mine Explosions and Fires in the U. S., during the Fiscal Year ended June 30, 1934. By D. Harrington and W. J. Fene.
6820—Some Suggestions as to Safety Rules to Be Printed or Mimeographed for the Guidance of Bituminous Coal Mine Employees. By D. Harrington, J. J. Forbes and W. J. Fene.
6821—Tungsten—Part I. By Wm. O. Vanderburg.
6823—Mining Methods and Costs at the Mine of the St. Joseph Lead Co., Atlanta, Idaho. By E. D. Gardner.
6824—Mining and Milling Methods at the Big Jim Mine, Oatman, Arizona. By C. H. Johnson.
6825—Summary of Drifting and Crosscutting Cost Data. By C. F. Jackson.
6826—Sand and Gravel Excavation: Part 3: Hydraulic Dredge, Clamshell Dredge, Ladder Dredge, and Dipper Dredge. By J. R. Thoenen.
6827—Safety Posters at the Calumet & Hecla Mines. By F. S. Crawford.
6828—Review of Coal-Mine Fatalities in Indiana during the last 3 months of 1932 and the Calendar Year 1933. By C. A. Herbert.
6829—Bituminous Coal Mine Safety Inspection Outline. By G. W. Grove and W. J. Fene.
6830—Minor Mineral Fertilizer Materials. By Bertrand L. Johnson.
6831—The Joseph A. Holmes Safety Assoc. and its Awards. By D. Harrington.
6832—Maintaining the Permissibility of Electric Cap Lamps. By D. H. Zellers and A. B. Hooker.
6833—Sodium Sulphate. By Paul M. Tyler.
6835—Review of Literature on Effects of Breathing Dusts with Special Reference to Silicosis.

Part I.
Chapter 1. Definition and Classification of Dusts.
Chapter 2. Sources of Exposure to Dusts.
Chapter 3. Physiological Effects of Breathing Dusts.
By D. Harrington and Sara J. Davenport.

Report of Investigations:

3243—Smelting in the Lead Blast Furnace. Handling Zinciferous Charges. XI—Preparation of the Charge by Sintering. By G. L. Oldright and Virgil Miller.
3244—Smelting in the Lead Blast Furnace. Handling Zinciferous Charges. XII—The Gases within the Blast Furnace at Top and Tuyeres. By G. L. Oldright and Virgil Miller.
3245—Smelting in the Lead Blast Furnace. Handling Zinciferous Charges. XIII—Accretions at Various Elevations within Blast Furnace and Factors Governing Manner and Rate of Descent of Stock Column. By G. L. Oldright and Virgil Miller.
3247—Beneficiating Cement Raw Materials by Agglomeration and Tabling. By F. P. Diener, J. Bruce Clemmer and S. R. B. Cooke.
3248—Dewatering Clay Suspensions by Spray Evaporation. By Hewitt Wilson, George A. Page and Vance S. Cartwright.
3252—Tabulated Analyses of Texas Crude Oils. By Gustav Wade.
3252A—Erratum, Substitution of Pages 3 and 4 in 3252.
3256—Progress Reports—Metallurgical Division.
8. Studies in Zinc Metallurgy. By H. A. Doerner, Thomas B. Brighton and Carl L. Dice.
3262—Progress Reports—Metallurgical Division.
9. Thermodynamic Data on Some Metallurgically Important Compounds of Lead and the Antimony-Group Metals and Their Applications. By Chas. G. Maier.
3263—Froth Flotation of Coal; Sulphur and Ash Reduction. By H. F. Yancey and J. A. Taylor.
3264—Smelting in the Lead Blast Furnace. Handling Zinciferous Charges. XV—Slags from the Trail Blast Furnaces. By G. L. Oldright and Virgil Miller.
3265—Assay of Black Sands. By Paul Hopkins.

3266—Recent Trends in Man-Hour Production at Iron-Ore Mines. By H. W. Davis, W. W. Adams and O. E. Kiessling.
3267—Bumps in Coal Mines of the Cumberland Field, Kentucky and Virginia—Causes and Remedy. By Geo. S. Rice.
3268—Progress Reports—Metallurgical Division.
10. Mineral Physics Studies. By R. S. Dean and others.
3269—Special Multiple-Shot Blasting Units. By A. B. Hooker and E. J. Coggeshall.
3270—Survey of Fuel Consumption at Refineries in 1933. By G. R. Hopkins.

Report of Investigations:
3271—Concentration of the Potash Ores of Carlsbad, New Mexico, by Ore Dressing Methods. By Will H. Coghill, F. D. DeVaney, J. Bruce Clemmer and S. R. B. Cooke.
3273—Coke-Oven Accidents in the United States during the Calendar Year 1933. By W. W. Adams and V. E. Erwin.

U. S. Bureau of Reclamation:
Mineral Resources and Possible Industrial Development in the Region Surrounding Boulder Dam.

Government, State

Arizona Bureau of Mines, Tucson:
Bull. 138—Treating Gold Ores (2d Edition). By T. G. Chapman.
Idaho Inspector of Mines, Boise:
36th Annual Report of the Mining Industry of Idaho, 1934.
Illinois State Geological Survey, Urbana:
R. I. No. 35.
Mississippi State Geological Survey, University:
Bull. 22A—Supplementary Report on Bentonite in Miss. By H. McD. Morse.
26 —The Highland Church Sandstone as a Building Stone. By W. C. Morse.
Missouri Geological Survey and Water Resources, Rolla:
Biennial Report of the State Geologist.
Montana Bureau of Mines and Geology, Butte:
Memoir No. 11—Geology and Artesian Water Resources along Missouri and Milk Rivers in Northeastern Montana. By E. S. Perry.
New Jersey Department of Conservation and Development, Trenton:
Bulletin 42—The Mineral Industry of New Jersey for 1933.
Washington State Division of Geology, Olympia:
R. I. No. 2—Oil and Gas Possibilities of Western Whatcom Co.
Annual Report.

Government, Foreign

Alberta Research Council, Edmonton:
Annual Reports.
Argentina Direccion General de Minas y Geologica, Buenos Aires:
Publications.
South Australia Department of Mines, Adelaide:
Annual Report, 1933.
Brazil Ministerio da Agricultura da Brazil, Rio de Janeiro:
Reports.
British Columbia Department of Mines, Victoria:
Publications.
British Columbia Minister of Mines, Victoria:
Reports.
Canada Department of Mines, Ottawa:
Publications.
Geological Survey of Great Britain, London.
Museo de Historia Natural de Montevideo, Uruguay.
Secretaria de Industria, Comercio y Trabajo, Mexico, D. F.
New Zealand Geological Survey, Wellington.
Nova Scotia Department of Public Works and Mines, Halifax:
Annual Report on Mines, 1934.
Ontario Department of Mines, Toronto:
43d Annual Report
Preliminary Reports.
Quebec Bureau of Mines, Quebec:
Senneterre Map—Area, Abitibi District. By Bell and Bell.
Annual Report, 1933.

Societies and Educational Institutions

Academia de Ciencias y Artes de Barcelona, Spain:
Memorias.

Academy of Natural Sciences of Philadelphia:
  Proceedings.
American Association of Petroleum Geologists, Tulsa, Oklahoma.
  Bulletins.
American Geographical Society of New York:
  Geographical Review.
American Journal of Science, New Haven, Conn.
American Philosophical Society, Philadelphia:
  Proceedings.
Australian Museum, Sydney:
  Records.
California Academy of Sciences, San Francisco:
  Proceedings.
Canadian Institute of Mining and Metallurgy, Montreal:
  "Canadian Mining and Metallurgical Bulletin."
Carnegie Institution of Washington:
  360—Volcanic Activity and Hot Springs of Lassen Peak. By A. L. Day and E. T. Allen.
  378—Steam Wells and Other Thermal Activity at "The Geysers," California. By E. T. Allen and A. L. Day.
Cleveland Museum of Natural History, Cleveland, Ohio:
  Scientific Publications.
Colorado College Publications, Colorado Springs.
Colorado Scientific Society, Denver:
  Proceedings:
Commonwealth Club, San Francisco:
  Journals.
Economic Geology, Lancaster, Pa.
Field Museum of Natural History, Chicago:
  Geological Series.
Franklin Institute of the State of Pennsylvania, Lancaster, Pa.:
  Journals.
Geological Society of America, Columbia University, New York:
  Bulletins.
Geological Society of London:
  Abstracts of the Proceedings.
Institution of Mining and Metallurgy, London:
  Bulletins, Transactions.
Instituto Geologico de Mexico, Mexico, D. F.:
  Bulletins.
Journal of Geology, Chicago.
Library of Congress, Washington, D. C.:
  Monthly Check List of State Publications.
Mineralogical Society of America, Menasha, Wisconsin:
  "The American Mineralogist."
Mining and Metallurgical Society of America, New York:
  Bulletins.
Museu Nacional, Rio de Janeiro:
  Boletins.
National Research Council, Washington, D. C.:
  Annual Report for 1932–1933.
  Catalogue of Small-Scale Geologic Maps.
  Problems of Batholiths.
New York Academy of Sciences, New York:
  Annals, etc.
New York State Museum, Albany:
  Publications.
Northwest Scientific Association, Cheney, Wash.:
"Northwest Science."
Pacific Mineralogist, Los Angeles.
Pennsylvania State College, State College:
  Bulletins.
Philippine Journal of Science, Manila.
Royal Society of South Australia, Adelaide:
  Transactions and Proceedings.
Secretario de la Economia Nacional, Mexico, D. F.:
  Revista Industrial.
Bulletin of the Seismographic Stations, Berkeley, Cal.
Seismological Society of America, Stanford University:
  Bulletins.
Sierra Club, San Francisco:
  Bulletin.
Society of Economic Paleontologists and Mineralogists, Ft. Worth, Texas:
  "Journal of Paleontology."

Southern California Academy of Sciences, Los Angeles:
  Bulletins.
National Research Council, Washington, D. C.:
  Annual Report for 1933–1934.
  Continental Shelf off the Coast of California. By A. C. Lawson.
  Functions of the Division of Geology and Geography.
  A. Survey of Research Problems in Geographics.
  Geological Implications of the Doctrine of Isostasy. By A. C. Lawson.
  List of Manuscript Bibliographies in Geology and Geography.
  Recent Geological Work in Europe.
  Report of a Committee on the Measurement of Geologic Time. 1932 and 1934.
  Studies of Mean Sea Level.

Books

Gems, How to Know and Cut Them. By H. L. Thomson.
Geologic History at a Glance. By L. W. Richards and G. L. Richards, Jr.
Handbook of Ore Dressing. By A. W. Allen.

Maps

- U. S. G. S. Topographic Maps:
  - Arkansas:
    - Treat Quadrangle.
  - California:
    - Coal Oil Canyon Quadrangle.
    - Lake Quadrangle, Los Angeles Co.
    - Llano Quadrangle, Los Angeles Co.
    - Mint Canyon Quadrangle, Los Angeles Co.
    - Pentland Quadrangle.
    - Red Rover Quadrangle, Los Angeles Co.
    - Sawtelle Quadrangle, Los Angeles Co.
  - Louisiana:
    - Covington Quadrangle.
    - Denham Springs Quadrangle.
    - Ponchatoula Quadrangle.
  - Missouri:
    - Popular Bluff Quadrangle.
    - Skeston Quadrangle.
    - Zalma Quadrangle.
  - Washington:
    - Mt. Ranier National Park.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
California Journal of Development, San Francisco.
California Mining Journal, Auburn.
California Oil World, Los Angeles.
California Safety News, San Francisco.
Canadian Mining Journal, Gardenvale, Quebec.
Chemical and Metallurgical Engineering, New York City.
Chemical Engineering and Mining Review, Melbourne, Australia.
Commonwealth, San Francisco.
Colorado School of Mines, Golden, Colorado.
Engineering and Mining Journal, New York City.
Fuel Oil, Chicago, Illinois.
Fusion Facts, Whittier, California.
Geophysical Prospector, Los Angeles.
Gold, Toronto, Canada.
Grizzly Bear, Los Angeles.
Hercules Mixer, Wilmington, Delaware.
Independent Monthly, Tulsa, Oklahoma.
Lubrication, The Texas Co., New York City.
Metals and Alloys, Pittsburgh, Pa.
Mineralogist, Portland, Ore.
Mining Congress Journal, Washington, D. C.
Mining Journal, London.
Mining Journal, Phoenix, Arizona.
Mining and Metallurgy, New York City.
Mining Review, Salt Lake City.
National Sand and Gravel, Washington, D. C.

Nickel Cast Iron News, New York City.
Northwest Mining, Spokane, Wash.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil, Paint and Drug Reporter, New York City.
Oil Weekly, Houston, Texas.
Pacific Purchaser, San Francisco.
Petroleum World, Los Angeles.
Pit and Quarry, Chicago.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago.
Rocks and Minerals, Peekskill, New York.
Scientific American, New York City.
Southwest Builder and Contractor, Los Angeles.
Stabilizer, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York City.
Western Mining News, San Francisco.

Newspapers.

The following papers are received and kept on file in the library:

Alaska Weekly, Seattle, Washington.
Amador Dispatch, Jackson, California.
Banner, Sonora, California.
Barstow Printer, Barstow, California.
Bridgeport Chronicle-Union, Bridgeport, California.
Calaveras Californian, Angels Camp, California.
Calaveras Prospect, San Andreas, California.
Colusa Sun-Herald, Colusa, California.
Daily Commercial News, San Francisco, California.
Daily Midway Driller, Taft, California.
Del Norte Triplicate, Crescent City, California.
Denver Mining Record, Denver, Colorado.
Inland Oil Index, Casper, Wyoming.
Inyo Independent, Independence, California.
Inyo Register, Bishop, California.
Las Vegas Age, Las Vegas, Nevada.
Livermore Herald, Livermore, California.
Mariposa Gazette, Mariposa, California.
Mercury Register, Oroville, California.
Mining & Industrial News, San Francisco, California.
Mojave Miner, Kingman, Arizona.
Mojave-Randsburg Record, Mojave, California.
Morning Union, Grass Valley, California.
Mountain Messenger, Downieville, California.
National Industrial Review, San Francisco, California.
Needles Nugget, Needles, California.
Nevada City Nugget, Nevada City, California.
Nevada Mining Bulletin, Las Vegas, Nevada.
Oil Marketer, Bayonne, New Jersey.
Placer Herald, Auburn, California.
Plumas Independent, Quincy, California.
San Diego News, San Diego, California.
Shasta Courier, Redding, California.
Siskiyou News, Yreka, California.
Stockton Record, Stockton, California.
Tehachapi News, Tehachapi, California.
Terra Bella News, Terra Bella, California.
Tuolumne Independent, Sonora, California.
Tuolumne Prospector, Tuolumne, California.
Union Democrat, Sonora, California.
Ventura County News, Ventura, California.
Waterford News, Waterford, California.
Weekly Trinity Journal, Weaverville, California.
Western Mineral Survey, Salt Lake City, Utah.
Western Sentinel, Etna Mills, California.

PRODUCERS AND CONSUMERS

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by this division to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of *Mining in California* was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of CALIFORNIA JOURNAL OF MINES AND GEOLOGY, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes,' and sent to those on the mailing list of CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

EMPLOYMENT SERVICE

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

Technical men, or those qualified for supervisory positions, and vacancies of like nature only, are registered, as no attempt will be made to supply common mine and mill labor.

Registration cards for the use of both prospective employers and employees may be obtained upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded. Parties interested should communicate direct with our San Francisco office.

PUBLICATIONS OF THE DIVISION OF MINES

During the past fifty-four years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the State, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have usually been limited, the reports and bulletins mentioned are printed in limited editions many of which are now entirely exhausted.

Copies of such publications are available, however, in the offices of the Division of Mines, in the Ferry Building, San Francisco; State Building, Los Angeles; State Office Building, Sacramento; Redding; and Division of Oil and Gas at Santa Barbara, Taft, Bakersfield. They may also be found in many public, private and technical libraries in California and other States and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

Money orders should be made payable to the Division of Mines.

NOTE.—The Division of Mines frequently receives requests for some of the early Reports and Bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

REPORTS

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----	----
Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	$0.50	$0.10
Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	.50	.10
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----	----
Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	1.00	.15
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	1.00	.20
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:		
Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	.50	.10
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50	.10
Mines and Mineral Resources, Del Norte, Humboldt and Mendocino Counties, 59 pp., paper	.25	.10
Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pp., paper	.50	.10
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.35	.10
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----	----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915: A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou and Trinity Counties, 974 pp., 275 illustrations, cloth	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916. Fletcher Hamilton:		
Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	.65	.10
Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties, 91 pp., paper	.50	.05
Mines and Mineral Resources, El Dorado, Placer, Sacramento and Yuba Counties, 198 pp., paper	.65	.10
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara and Ventura Counties, 183 pp., paper	.65	.10
Mines and Mineral Resources, Los Angeles, Orange and Riverside Counties, 136 pp., paper	.50	.10
Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	.65	.10

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917: A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1917–1918, Fletcher Hamilton:		
Mines and Mineral Resources of Nevada County, 270 pp., paper	$0.75	$0.15
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50	.10
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50	.10
Seventeenth Report of the State Mineralogist, 1920, 'Mining in California during 1920,' Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75	.25
Eighteenth Report of the State Mineralogist, 1922, 'Mining in California,' Fletcher Hamilton. Chapters published monthly beginning with January, 1922:		
**January, **February, March, April, May, June, July, August, September, October, **November, December, 1922	.25	.05
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	.25	.05
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, **July, October, 1924, per copy	.25	.05
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange Counties	.25	.05
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura Counties	.25	.05
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego Counties	.25	.10
**October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara Counties	----	----
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
**January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz Counties	----	----
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial Counties	.25	.10
July, 1926, Mines and Mineral Resources of Marin and Sonoma Counties	.25	.05
**October, 1926, Mines and Mineral Resources of El Dorado and Inyo Counties, also report on Minaret District, Madera County	----	----
Chapters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1927, Mines and Mineral Resources of Contra Costa County; Santa Catalina Island	.25	.10
April, 1927, Mines and Mineral Resources of Amador and Solano Counties	.25	.05
**July, 1927, Mines and Mineral Resources of Placer and Los Angeles Counties	----	----
October, 1927, Mines and Mineral Resources of Mono County	.25	.05
Chapters of Twenty-fourth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1928, Mines and Mineral Resources of Tuolumne County	.25	.05
April, 1928, Mines and Mineral Resources of Mariposa County	.25	.05
July, 1928, Mines and Mineral Resources of Butte and Tehama Counties	.25	.05
October, 1928, Mines and Mineral Resources of Plumas and Madera Counties	.25	.05
Chapters of Twenty-fifth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
**January, 1929, Mines and Mineral Resources of Lassen, Modoc and Kern Counties; also on Special Placer Machines	----	----

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
April, 1929, Mines and Mineral Resources of Sierra, Napa, San Francisco and San Mateo Counties	$0.25	$0.10
July, 1929, Mines and Mineral Resources of Colusa, Fresno and Lake Counties	.25	.10
October, 1929, Mines and Mineral Resources of Glenn, Alameda, Mendocino and Riverside Counties	.25	.10
Chapters of Twenty-sixth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1930, Mines and Mineral Resources of Santa Clara County; also Barite in California	.25	.05
April, 1930, Mines and Mineral Resources of Nevada County; also Mineral Paint Materials in California	.25	.05
July, 1930, Mines and Mineral Resources of Yuba and San Bernardino Counties; also Commercial Grinding Plants in California	.25	.10
October, 1930, Mines and Mineral Resources of Butte, Kings and Tulare Counties; also Geology of Southwestern Mono County (Preliminary)	.25	.10
Chapters of Twenty-seventh Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1931, Preliminary Report on Economic Geology of the Shasta Quadrangle. Beryllium and Beryl. The New Tariff and Nonmetallic Products. Crystalline Talc. Decorative Effects in Concrete	.25	.10
April, 1931, Stratigraphy of the Kreyenhagen Shale. Diatoms and Silicoflagellates of the Kreyenhagen Shale. Foraminifera of the Kreyenhagen Shale. Geology of Santa Cruz Island	.25	.10
July, 1931. (Yuba, San Bernardino.) Feldspar, Silica, Andalusite and Cyanite Deposits of California. Note on a Deposit of Andalusite in Mono County; its occurrence and chemical importance. Bill creating Trinity and Klamath River Fish and Game District and its effect upon mining	.25	.10
October, 1931. (Alpine.) Geology of the San Jacinto Quadrangle south of San Gorgonio Pass, California. Notes on Mining Activities in Inyo and Mono Counties in July, 1931	.25	.05
Chapters of Twenty-eighth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1932, Economic Mineral Deposits of the San Jacinto Quadrangle. Geology and Physical Properties of Building Stone from Carmel Valley. Contributions to the Study of Sediments. Sediments of Monterey Bay. Sanbornite	.25	.10
**April, 1932. Elementary Placer Mining Methods and Gold Saving Devices. The Pan, Rocker and Sluice Box. Prospecting for Vein Deposits. Bibliography of Placer Mining	----	----
Abstract from April quarterly: Elementary Placer Mining Methods and Gold Saving Devices. Types of Deposits, Simple Equipment. Special Machines. Dry Washing. Black Sand Treatment. Marketing of Products. Placer Mining Areas. Laws. Prospecting for Quartz Veins. Bibliography (mimeographed)	.20	.05
July-October. (Ventura.) Report accompanying Geologic Map of Northern Sierra Nevada. Fossil Plants in Auriferous Gravels of the Sierra Nevada. Glacial and Associated Stream Deposits of the Sierra Nevada. Jurassic and Cretaceous Divisions in the Knoxville-Shasta Succession of California. Geology of a Part of the Panamint Range. Economic Report of a Part of the Panamint Range. Acquiring Mining Claims Through Tax Title. The Biennial Report of State Mineralogist	.50	.15
Chapters of Report XXIX, 1933 (quarterly): titled "California Journal of Mines and Geology," containing the following:		
January-April. Gold Deposits of the Redding and Weaverville Quadrangles. Geologic Formations of the Redding-Weaverville District, Northern California. Geology of Portions of Del Norte and Siskiyou Counties. Applications of		

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Geology to Civil Engineering. The Lakes of California. Discovery of Piedmontite in the Sierra Nevada. Tracing 'Buried River' Channel Deposits by Geomagnetic Methods. Geologic Map of Redding-Weaverville District, showing gold mines and prospects. Geologic Map showing various mines and prospects of part of Del Norte and Siskiyou Counties	$0.80	$0.15
July-October. Gold Resources of Kern County. Limestone Deposits of the San Francisco Region. Limestone Weathering and Plant Associations of the San Francisco Region. Booming. Death Valley National Monument, California. Placer Mining Districts, Senate Bill 480. Navigable Waters, Assembly Bill 1543	.80	.10
Chapters of Report XXX, 1934 (quarterly): titled "California Journal of Mines and Geology," containing the following:		
January. Resurrection of Early Surfaces in the Sierra Nevada. Geology and Mineral Resources of Northeastern Madera County. Geology and Mineral Deposits of Laurel and Convict Basins, Southwestern Mono County. Notes on Sampling as Applied to Gold Quartz Deposits	.40	.10
April-July. Elementary Placer Mining in California and Notes on the Milling of Gold Ores	.80	.10
October. Current Mining Developments in Northern California. Current Mining Activity in Southern California. Geology and Mineral Resources of the Julian District, San Diego County. Geology and Mineral Resources of Elizabeth Lake Quadrangle. Dry Placers of Northern Mojave Desert. Biennial Report of State Mineralogist. Assessment Work Within Withdrawn Areas	.40	.10
Chapters of Report XXXI, 1935 (quarterly): titled "California Journal of Mines and Geology"		
January. Review of Gold Mining in East-Central, 1934. Current Mining Activities in the San Francisco District with Special Reference to Gold. Geological Investigation of the Clays of Riverside and Orange Counties, Southern California. Information regarding Mining Loans by the Reconstruction Finance Corporation	.40	.10
Subscription, $1.50 in advance (by calendar year, only).		
Chapters of State Oil and Gas Supervisor's Report:		
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free	----
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:		
**April, **May, **June, **July, **August, **September, **October, **November, **December, 1919	----	----
**January, **February, **March, **April, **May, **June, **July, **August, **September, **October, **November, **December, 1920	----	----
January, **February, **March, April, **May, **June, **July, August, **September, **October, **November, **December, 1921	Free	----
January, February, March, April, May, June, **July, **August, September, **October, **November, December, 1922	Free	----
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(Published quarterly beginning July, 1929.)		

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BULLETINS

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**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps	----	----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887)	----	----
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations	----	----
**Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations	----	----
**Bulletin No. 7. Mineral Production of California, by Counties, for the year 1894, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 8. Mineral Production of California, by Counties, for the year 1895, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations	----	----
**Bulletin No. 10. A bibliography Relating to the Geology, Paleontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	----	----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara Counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations	----	----
**Bulletin No. 12. Mineral Production of California, by Counties, for 1896, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 13. Mineral Production of California, by Counties, for 1897, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 14. Mineral Production of California, by Counties, for 1898, by Charles G. Yale	----	----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means, 1899	----	----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations	----	----
**Bulletin No. 17. Mineral Production of California, by Counties, for 1899, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations	----	----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps	----	----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899	----	----
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**Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, 9 maps	----	----
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**Bulletin No. 68. Mineral Production for 1913, with County Maps and Mining Laws, by E. S. Boalich. 160 pp.	----	----
**Bulletin No. 69. Petroleum Industry of California, with Folio of Maps (18 by 22), by R. P. McLaughlin and C. A. Waring. 1914, 519 pp., 13 illustrations, 83 figs. [18 plates in accompanying folio.]	----	----
**Bulletin No. 70. Mineral Production for 1914, with County Maps and Mining Laws. 184 pp.	----	----
**Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W, Bradley. 193 pp. 4 illustrations	----	----
**Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp.	----	----
**Reconnaissance Geologic Map (of which Bulletin 72 is explanatory), in 23 colors. Scale: 1 inch = 12 miles. Mounted	----	----
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the Fiscal Year 1915–16, by R. P. McLaughlin. 278 pp., 26 illustrations	----	----
Bulletin No. 74. Mineral Production of California in 1916, with County Maps, by Walter W. Bradley. 179 pp., 12 illustrations	**Free**	**.15**
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Bulletin No. 79. Magnesite in California, by Walter W. Bradley. 1925, 147 pp., 62 photographs, 11 line cuts and maps, cloth	**1.00**	**.10**
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**Bulletin No. 82. Second Annual Report of the State Oil and Gas Supervisor, for the Fiscal Year 1916–1917, by R. P. McLaughlin. 1918, 412 pp., 31 illustrations, cloth	----	----

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Bulletin No. 86. California Mineral Production for 1918, with County Maps, by Walter W. Bradley. 1919, 212 pp., paper	Free	.15
**Bulletin No. 87. Commercial Minerals of California, with notes on their uses, distribution, properties, ores, field tests, and preparation for market, by W. O. Castello. 1920, 124 pp., paper	----	----
Bulletin No. 88. California Mineral Production for 1919, with County Maps, by Walter W. Bradley. 1920, 204 pp., paper	Free	.15
**Bulletin No. 89. Petroleum Resources of California, with Special Reference to Unproved Areas, by Lawrence Vander Leck. 1921, 12 figures, 6 photographs, 6 maps in pocket, 186 pp., cloth	----	----
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**Bulletin No. 97. California Mineral Production for 1925, by Walter W. Bradley. 1926, 172 pp., paper	----	----
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Bulletin No. 104. Bibliography of the Geology and Mineral Resources of California, to the end of 1930, by Solon Shedd	2.00	.15
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Bulletin No. 106. Manner of Locating and Holding Mineral Claims in California (with forms)	.25	----
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Bulletin No. 109. California Mineral Production and Directory of Mineral Producers for 1932, by Henry H. Symons, 200 pp. paper	.25	.10
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**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin, 4 pp.	----	----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp.	Free	$0.05
**Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper	----	----
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**Preliminary Report No. 6. A Review of Mining in California During 1919. By Fletcher Hamilton, 1920. 43 pp. Paper	----	----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper	----	----
**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. By Fletcher Hamilton, 1922. 68 pp. Paper	----	----

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**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper	----	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper	.10	----
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923	Free	.15 annually

MAPS

Register of Mines With Maps

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Register of Mines, with Map, Butte County	$0.25	$0.05
**Register of Mines, with Map, Calaveras County	----	----
**Register of Mines, with Map, El Dorado County	----	----
**Register of Mines, with Map, Inyo County	----	----
**Register of Mines, with Map, Kern County	----	----
**Register of Mines, with Map, Lake County	----	----
**Register of Mines, with Map, Mariposa County	----	----
**Register of Mines, with Map, Nevada County	----	----
**Register of Mines, with Map, Placer County	----	----
**Register of Mines, with Map, Plumas County	----	----
**Register of Mines, with Map, San Bernadino County	----	----
Register of Mines, with Map, San Diego County	.25	.05
Register of Mines, with Map, Santa Barbara County (1906)	.25	.05
**Register of Mines, with Map, Shasta County	----	----
**Register of Mines, with Map, Sierra County	----	----
**Register of Mines, with Map, Siskiyou County	----	----
**Register of Mines, with Map, Trinity County	----	----
**Register of Mines, with Map, Tuolumne County	----	----
Register of Mines, with Map, Yuba County (1905)	.25	.05
Register of Oil Wells, with Map, Los Angeles City (1906)	.35	.05

OTHER MAPS

**Map of California, Showing Mineral Deposits (50 x 60 in.)	----	----
**Map of Forest Reserves in California	----	----
**Mineral and Relief Map of California	----	----
**Map of El Dorado County, Showing Boundaries, National Forests	----	----
**Map of Madera County, Showing Boundaries, National Forests	----	----
**Map of Placer County, Showing Boundaries, National Forests	----	----
**Map of Shasta County, Showing Boundaries, National Forests	----	----
**Map of Sierra County, Showing Boundaries, National Forests	----	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----	----
**Map of Mother Lode Region	----	----
**Map of Desert Region of Southern California	----	----
Map of Minaret District, Madera County	.20	.05
Map of Copper Deposits in California	.05	----
**Map of Calaveras County	----	----
**Map of Plumas County	----	----
**Map of Trinity County	----	----
**Map of Tuolumne County	----	----
Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60	.05
**Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	----	----
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Unmounted	.75	.05
Mounted	2.50	.15
**Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels, accompanying Bulletin No. 92. In 4 colors (also sold singly)	----	----

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Geologic Map of Northern Sierra Nevada, showing Tertiary River Channels and Mother Lode Belt, accompanying July-October Chapter of Report XXVIII of the State Mineralogist. (Sold singly)	$0.25	$0.05
Map of Northern California, showing rivers and creeks which produced placer gold in 1932	.20	.05
Mother Lode Geologic and claim maps in 5 county sections: El Dorado, Amador, Calaveras, Tuolumne and Mariposa. Single sections 10c. Set of 5	.50	----
Map of Mariposa County showing principal gold mines	.10	----

OIL FIELD MAPS

The maps are revised from time to time as development work advances and ownerships change.

	Price (including postage)
Map No. 1—Sargent, Santa Clara County	$0.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	1.00
Map No. 3—Santa Maria, including Casmalia and Lompoc	1.00
Map No. 4—Brea Olinda & (East Portion) Coyote Hills, Los Angeles and Orange Counties	1.00
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Map No. 20—Long Beach, Los Angeles County	1.50
Map No. 21—Portion of District No. 4, showing boundaries of oil fields—Kern and Kings Counties	.75
Map No. 21-A—Portion of District No. 4, showing boundaries of oil fields—Kern County	.75
Map No. 21-B—Portion of District No. 5, showing boundaries of oil fields—Fresno, Kings and Kern Counties	.75
Map No. 22—Portion of District No. 3, showing boundaries of oil fields—Santa Barbara County	.75
Map No. 23—Portion of District No. 2, showing boundaries of oil fields—Ventura County	.75
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Map No. 34—Mt. Poso, Kern County	.75
Map No. 35—Round Mountain, Kern County	.75
Map No. 36—Kettleman Hills, Fresno, Kings and Kern Counties	1.25
Map No. 37—Montebello, Los Angeles County	1.00
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Map No. 45—Buttonwillow gas, Kern County	.75
Map No. 46—Richfield, Orange County	1.00
Map No. 47—Mountain View, Kern County	.75
Map No. 48—Mountain View and Edison, Kern County	1.25

DETERMINATION OF MINERAL SAMPLES

Samples (limited to two at one time) of any mineral found in the State may be sent to the Division of Mines for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the State. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

22920 12-35 2M

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES

DIVISION OF MINES

CORDIALLY INVITES YOU TO VISIT
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FOR THE PURPOSE OF FURTHERING
THE DEVELOPMENT OF THE

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WALTER W. BRADLEY,
State Mineralogist.

Third floor, Ferry Building, San Francisco, Cal. Branch Offices: State Building, Los Angeles; State Office Building, Sacramento; Chamber of Commerce, Redding; Bank of Italy Building, Bakersfield; San Marcos Building, Santa Barbara; Taft.

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
GEORGE D. NORDENHOLT, Director

DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO

WALTER W. BRADLEY State Mineralogist

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MINES AND GEOLOGY

QUARTERLY CHAPTER
OF
STATE MINERALOGIST'S REPORT XXXI

STATE DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO,
CALIFORNIA

25888

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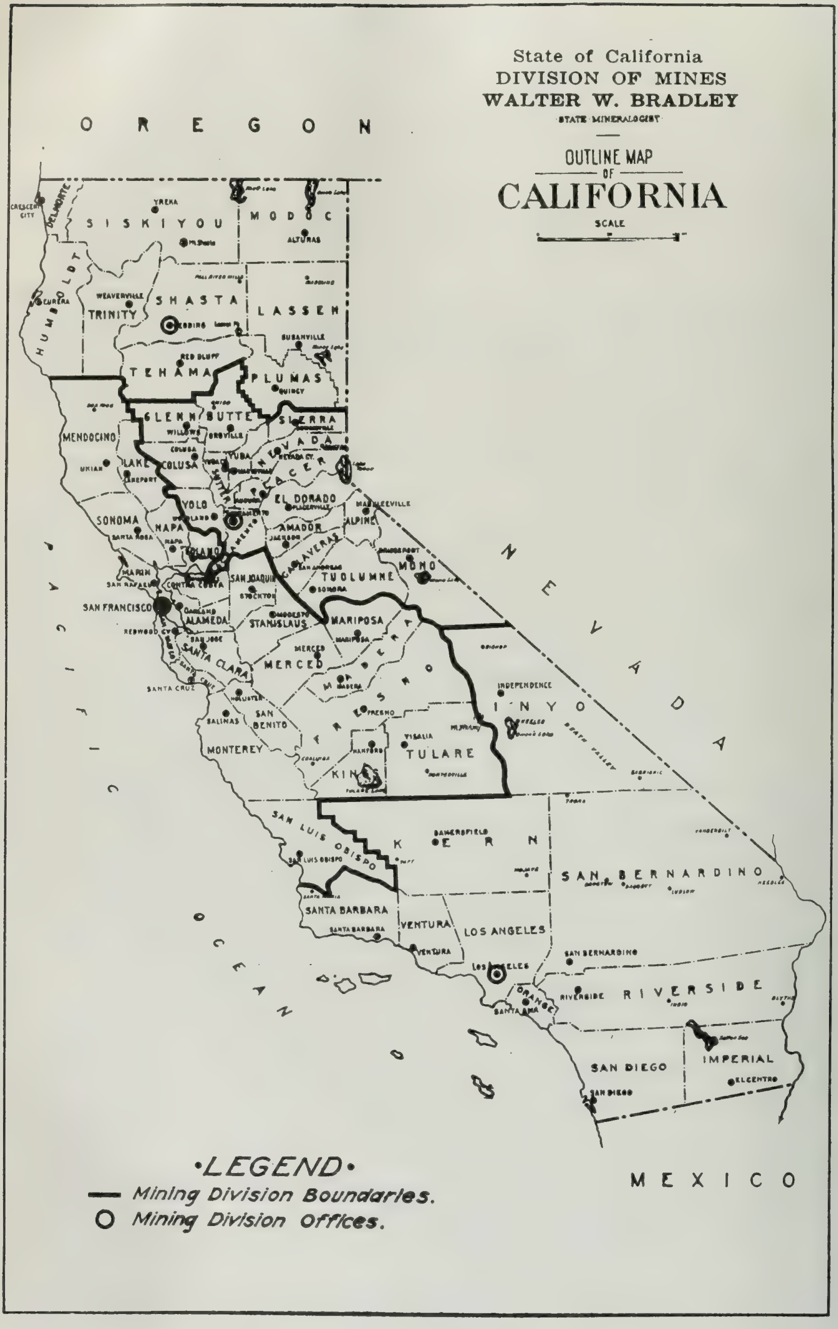
TABLE OF CONTENTS

Page
DISTRICT REPORTS OF MINING ENGINEERS 255
- Redding Field District 255
- Sacramento Field District 338
- San Francisco Field District 338
- Los Angeles Field District 338

GEOLOGIC BRANCH 339
OIL FIELD DEVELOPMENT OPERATIONS 340
SPECIAL ARTICLES 345
- Dams for Hydraulic Mining Debris 345
- Leasing System as Applied to Metal Mining 368
- Mine Financing in California 376
- New Laws Make Radical Change in Mining Rights 382

ADMINISTRATIVE 385
MINERALS AND STATISTICS 386
- Statistics 386
- Museum 388
- Laboratory 391

LIBRARY 392
PRODUCERS AND CONSUMERS 399
EMPLOYMENT SERVICE 400
PUBLICATIONS I



State of California
DIVISION OF MINES
WALTER W. BRADLEY
STATE MINERALOGIST

OUTLINE MAP
OF
CALIFORNIA

•LEGEND•
Mining Division Boundaries.
Mining Division Offices.

SCALE
OREGON
NEVADA
PACIFIC OCEAN
MEXICO
DEL NORTE
CRESCENT CITY
SISKIYOU
YREKA
MODOC
ALTURAS
HUMBOLDT
EUREKA
TRINITY
WEAVERVILLE
SHASTA
REDDING
LASSEN
SUSANVILLE
TEHAMA
RED BLUFF
PLUMAS
QUINCY
MENDOCINO
UKIAH
GLENN
WILLOWS
BUTTE
OROVILLE
SIERRA
NEVADA
NEVADA CY.
LAKE
LAKEPORT
COLUSA
YUBA
SUTTER
PLACER
EL DORADO
PLACERVILLE
YOLO
WOODLAND
SONOMA
SANTA ROSA
NAPA
SACRAMENTO
AMADOR
JACKSON
ALPINE
MARKLEEVILLE
SOLANO
MARIN
SAN RAFAEL
CONTRA COSTA
SAN JOAQUIN
STOCKTON
CALAVERAS
SAN ANDREAS
TUOLUMNE
SONORA
MONO
BRIDGEPORT
SAN FRANCISCO
OAKLAND
ALAMEDA
REDWOOD CY.
SAN MATEO
SAN JOSE
SANTA CLARA
SANTA CRUZ
STANISLAUS
MODESTO
MARIPOSA
MERCED
MADERA
FRESNO
HOLLISTER
SAN BENITO
SALINAS
MONTEREY
INYO
INDEPENDENCE
DEATH VALLEY
TULARE
VISALIA
PORTERVILLE
KINGS
HANFORD
COALINGA
SAN LUIS OBISPO
KERN
BAKERSFIELD
MOJAVE
SAN BERNARDINO
NEEDLES
SANTA BARBARA
SANTA MARIA
VENTURA
LOS ANGELES
ORANGE
SANTA ANA
RIVERSIDE
INDIO
BLYTHE
SAN DIEGO
IMPERIAL
EL CENTRO

PREFACE

The Division of Mines (formerly State Mining Bureau) is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

As a progressive step in advancing the interests of the mineral industry, and as permitting earlier distribution to the public, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923. Owing to a lack of funds for printing this was changed to a quarterly publication, beginning in September, 1923. For the same reason, beginning with the January, 1924, issue, it became necessary to charge a subscription price. This covers approximately the cost of printing.

Pages are numbered consecutively throughout the year and an index to the complete report is included annually in the closing number.

Beginning with the 1930 issues, the activities and progress of the Geological Branch are recorded also in these quarterly chapters. The important part that geology plays in the economic development of our mineral resources is further recognized in the change of title from *Mining in California* to CALIFORNIA JOURNAL OF MINES AND GEOLOGY, beginning with the January, 1933, chapter.

While current activities of all descriptions are covered in these chapters, the practice of issuing from time to time technical reports on special subjects will be continued as well. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters are subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Division of Mines is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

Types of Reports

In general the reports presented in these chapters are grouped into three classes:

1. Mines and mineral resources of a given county (describing kind, character, distribution and extent of development).
2. Specific economic and industrial mineral products (listing and describing the resources over the entire state of a given mineral substance, e.g. feldspar).
3. Geological reports on specific areas (recording results and conclusions, with maps, derived from field studies; and tied in with economic possibilities, and developments).

REPORTS OF DISTRICT MINING ENGINEERS

In 1919–1920 the Mining Bureau was organized into four main geographic divisions, with the field work delegated to a mining engineer in each district, working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively. This move brought the office into closer personal contact with operators, and it has many advantages over former methods of conducting field work, including lower traveling-expense bills for the Bureau's engineers. In 1923 the Redding and Auburn field offices were consolidated and moved to Sacramento.

The Redding office was reestablished in 1928, and the boundaries of each district adjusted. The counties now included in each of the four divisions and the location of the branch offices are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each district, prepared by the District Engineer, will continue to appear under the proper field division heading.

REDDING FIELD DISTRICT

CHAS. VOLNEY AVERILL, Mining Engineer

MINES AND MINERAL RESOURCES OF SISKIYOU COUNTY

Geography

Siskiyou County, one of the northernmost in the state, borders on the state of Oregon for a distance of 116 miles and is from 60 to 70 miles wide. It is bounded on the west by the coast counties of Humboldt and Del Norte, on the south by Trinity and Shasta, and on the east by Modoc. The region of interest to the miner is the portion lying west of the lava sheet, the western boundary of which coincides roughly with the Oregon branch of the Southern Pacific Railroad, traversing the county from north to south a little east of its center. The total area of the county is 6256 square miles, and the population is 25,500 persons by the census of 1930. This is concentrated largely along the railroad, at the county seat, and in Scott Valley.

The western mineral-bearing section is a succession of high mountains and deep canyons, forming the drainage basin of Klamath River and its tributaries. The Klamath follows a crooked course across the northern part of the county, receiving Shasta and Scott rivers, the principal streams draining the central part of the county; then turning south near Happy Camp where Indian Creek enters, it flows through a deep canyon, receiving the waters of Salmon River at Somes Bar on the southwest county line. The Salmon drains the rugged mineral-bearing area of the southwestern part of the county. Level land is in Shasta Valley and Scott Valley, both lying at an elevation of about 3000 ft. above sea level; also a few gravel bars along Klamath River between Hornbrook and Happy Camp, and such small valleys as those at the mouths of Seiad and Indian creeks, which accommodate the settlements of Seiad and Happy Camp.

Climate is indicated by the following table.[1] Orleans and Weitchpec are a little to the west in Humboldt County.

Place	*Elevation, feet*	*Average annual precipitation, inches*	*Average seasonal fall of snow, inches*	*Mean temperature F°*	*Highest temperature F°*	*Lowest temperature F°*
Dunsmuir	2285	57.06	70.5	---	---	----
Gilta	3300	53.24	108.5	---	---	----
Happy Camp	1132	39.91	----	---	---	----
Hornbrook	2154	14.47	----	---	105	—12
Macdoel	4258	15.07	44.3	43.7	102	—15
McCloud	3270	45.18	119.7	48.4	101	— 3
Montague	2450	12.21	----	51.2	108	—10
Mt. Shasta City	3555	35.59	117.3	48.8	108	— 9
Orleans	520	48.66	----	59.4	117	18
Walla Walla Creek	2570	24.80	----	---	---	----
Weitchpec	1700	73.96	51.5	52.4	102	17
Yreka	2625	17.49	----	50.8	108	— 4

While figures on snowfall are lacking for some of the points mentioned, that is not to be taken as an indication that no snow falls, as there is some snowfall in all parts of the county; and at the higher elevations the depth of fall is greater than any of the figures given in the table. The figures appearing under the name, Walla Walla Creek, represent records taken at a station of that name near Fort Jones, also at Fort Jones and at Scott Valley, in the years from 1853 to 1892.

GEOLOGY AND MINERAL RESOURCES

A map of the areal geology and a description of the general and economic geology of a part of Siskiyou County appeared in State Mineralogist's Report XXVII,[2] chapter for January, 1931, copies of which are available at offices of this division at 25¢ per copy plus 10¢ postage. The following descriptions of mining districts are reprinted in part from State Mineralogist's Report XXI,[3] chapter for October, 1925, which is now out of print.

The county has been celebrated in the past particularly because of its placer mines. Geologically these placer deposits differ from those in the east-central part of the state. In northwestern California the ancient auriferous gravels most actively mined are found in the form of a succession of terrace or bench deposits left at successively lower levels on the sides of the present river canyons as the streams cut downward to their present beds. The flows of lava and volcanic mud, which occurred in the Sierra Nevada during the Tertiary, and which preserved for the modern miner the ancient river channels, are lacking in this region. The terrace deposits of Siskiyou and adjacent counties date from Quaternary to Recent time. They parallel the present streams and have practically the same grades, and such earth movements as have occurred since their deposition have been probably slow and widespread, tending to rejuvenate the streams and accelerate their powers of erosion. The downward cutting rivers enriched their gravels by erosion of the ancient gold-bearing schists and the pre-existing river and shore gravels of the 'Cretaceous Island' of northern California. This Cretaceous island embraced practically all of western Siskiyou County, this area having been elevated above the sea since very early ages, and being devoid of Cretaceous or later marine sedimentary rocks west of the vicinity of Cottonwood Creek. The chief tributaries which themselves have been the scene of placer mining and have contributed gold to the Klamath, are Scott River, Salmon River, tributaries of Shasta River, and Humbug Creek, all entering from the south, and Indian, Beaver and Cottonwood creeks from the north.

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[1] U. S. Department of Agriculture, Weather Bureau, Summary of Climatological Data for the United States by Sections, Reprints of Sections 15 and 16. (Data are for periods earlier than 1923.)

[2] Averill, C. V., Preliminary Report on Economic Geology of the Shast Quadrangle, Cal. State Mineralogist's Report XXVII, chapter for January, 1931.

[3] Logan, C. A., Siskiyou County, Cal. State Mineralogist's Report XXI, chapter for October, 1925.

Scott River Region.

On Scott River early day placer mining camps flourished on the South Fork around Callahan and at Scott Bar, 3 to 4 miles from the mouth of the main stream. There is still considerable unworked gravel near Callahan. This is characterized by lack of grade and dump, and heavy boulders in places. The small area at Scott Bar was extremely rich. There remains quite an area of placer ground at the Roxbury Mine, and some high ground on both sides of Scott River, similar to the Quartz Hill diggings, where auriferous seams and veins of quartz are being worked by the hydraulic process. This seam belt has been considered responsible for the enrichment of the river below its crossing. It is noteworthy that from Callahan to Scott Bar the river itself has yielded little gold, but considerable profitable mining has been done in Quartz Valley, an arm of Scott Valley west of the present river. The gold on the west side of this valley was derived from an ancient channel, probably of Scott River, remnants of which are to be seen at Little Sniktaw Valley, and it can be traced southeastward upstream past Shackelford and Mill creeks, the Pinery workings (formerly Stockton Gravel Mining Company) and old Etna Mills. In places this channel has been entirely eroded into the valley, but elsewhere it is in place and has been worked on a small scale only, because of lack of water. It is a large channel with rather heavy, tight wash. Another class of deposit mined here was derived from local erosion of auriferous seams and small veins in the hills separating Quartz Valley from Oro Fino and Scott Valley. Quartz Valley has interesting possibilities for placer mining yet, but as the ground mentioned near its lower end has not been tested, it is not known whether it could be dredged, or would have to be worked by drifting. The ground is probably quite deep.

North Central Region.

Humbug district, northwest of Yreka and south of Klamath River; Cottonwood district, north of the Klamath, and quartz properties in the vicinities of Yreka, Fort Jones, Cherry Creek and other small quartz and pocket mining districts, may all be grouped together geologically. They occupy an area of 'Paleozoic Metamorphics' which includes very old rocks, the youngest of which may be Carboniferous and the oldest Cambrian, but which can not be definitely placed in the geologic column because of a lack of fossils. Both the igneous and originally sedimentary members of this 'catch-all' classification have been altered. Limestone, slate, some jasper, quartz porphyry, diorite, diabase, hornblende schists, and great masses of serpentine occur. The Paleozoic metamorphics have been compressed and show schistosity generally striking north to northeast and dipping east. Some of the principal veins follow this same strike and dip. There have been several subsequent minor movements, indicated by faults, shear zones and narrow veins and seams of quartz, striking in different directions. These in many cases faulted the earlier veins, as at the Hazel Mine. Many of the smaller pockety deposits are associated with intrusives such as diabase. In the Humbug district, some good ores were worked in serpentine, the principal mines having been the Boyle, Mountain Belle and Spencer. In general the work has been superficial. The best known mines in this entire region are the Morrison and Carlock, in Quartz Valley district, 4 miles northwest of Greenview, and the Hazel Mine southwest of Hornbrook.

Placer mining in this region has been on a small scale in later years, due to exhaustion of the more accessible ground and the protracted shortage of water. Developments in dredging are mentioned under the heading, Gardella Dredge.

From Cottonwood Creek southward along Shasta Valley, and past Yreka, extend the ancient sedimentary deposits flanking on the east what was formerly the so-called 'Cretaceous Island,'* previously mentioned. These beds consist of clay shales, sandstones, and shore gravels or conglomerates. The shale and sandstone contain beds of coal, and some of the beds are remarkably rich in shell remains and casts. This series in the region of the coal workings south of Ager, dips east 23° to 40°, the former figure being nearer the normal dip. These beds have been broken by a series of basaltic intrusions which show in knolls throughout the valley. The conglomerate was cut by Klamath River and its nearby small tributaries in the region of Hornbrook and Cottonwood Creek, and was extensively eroded. This conglomerate was gold bearing and contributed a part of the gold mined from the placers of Cottonwood, Rancheria, and other nearby creeks, and the immediate section of the river. Eastward of the conglomerate, the gravels of Klamath River are said to be barren. A very interesting retailed account of this gold-bearing conglomerate written by R. L. Dunn, appeared in the Twelfth Report of the State Mineralogist, pages 459–471. The placers of the Cottonwood region, including Rancheria Creek, are estimated to have yielded about $4,000,000. According to figures of yield reported by Dunn in the above paper, from workings then being mined, the conglomerate in the Blue Gravel Mine yielded 60 cents per square foot of bedrock when hydraulicked, this being only a part of the gold content, due to loss in the unbroken masses of conglomerate passing over the dump. The portion next the bedrock, when worked in an arrastra, paid 88 cents per square foot of bedrock. The conglomerate is overlain by Cretaceous sediments. The easterly area of sandstone and shale has been classified as Tertiary. Several unsuccessful attempts have been made to bring in oil wells in this vicinity and southward. Gas (probably dry marsh gas) was reported from a well 3½ miles south of Montague on the road to Grenada, and gas and alkaline water came from another shallow well. Six miles southeast of Montague, in the valley of Little Shasta River, some fresh water springs have been observed to emit gas.

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* See State Mineralogist's Report XXVII, pp. 5–25, for general geology of this area.

All the north-central portion of the county, as described above, is accessible by roads from Yreka and other nearby points on the Pacific highway. Yreka, the county seat, is 286 miles north of Sacramento by paved highway. The entire region is served with electric power by California-Oregon Power Company. Timber is lacking in the Shasta Valley section, but is obtainable in the western part of the area. Elevation of this region ranges from 2000 feet to 5000 feet and there is some snowfall in all parts of it.

Klamath River District.

Until a few years ago the terrace deposits and bars along the Klamath River, and the placers along several of its tributaries, were the scene of the principal mining operations in the northwestern part of the county.

The country tributary to the Klamath on both sides remains for the most part difficult of access. The road following the river from the Pacific highway near Hornbrook to Martins Ferry climbs over the Bald Hills of Humboldt County to a connection at Orick with the coast highway. It is 76 miles from Hornbrook to Happy Camp over this road. For a distance of 120 miles from near Hornbrook to Somes Bar, it follows the course of the Klamath River in this county and makes accessible one of the most extensive mining regions of the state. While the smaller and more easily worked placers along the river have been mined, there remain many terrace gravel deposits of interest to the hydraulic miner and numerous low bars offering possibilities for small scale drift mining operations. The gold quartz veins have not yet been prospected far enough to permit a fair opinion of their possibilities, but some very promising showings are being made. The area from the river northward to the Oregon state line and westward to Del Norte County, comprising many separate isolated districts, may be classed as the base metal district. At the west end, in the Preston Peak country, are numerous small copper prospects, now all idle. The Buzzard Hill Mine on the south and the Grey Eagle property north of Happy Camp mark a valuable copper mining district, sufficient work having been done to prove large orebodies in the latter mine. Quicksilver ores occur along the watersheds of Beaver Creek and Empire Creek, and copper and zinc ores have been noticed in the latter locality. From Indian Creek eastward to the railroad a number of gold quartz mines, mostly of pockety nature, have been opened. Prospecting and development of such properties is now going on along the upper courses of Indian, Thompson, Horse, Beaver and other creeks. On Independence Creek, 14 miles south of Happy Camp, the Independence Mine has made a fine showing of phenomenally rich gold specimen ore.

The Klamath River district as a whole is well supplied with standing timber and water for mining purposes. While the people of California have forbidden the building of dams in the Klamath River, the question of utilizing waters of the river for hydro-electric power generation is complicated by the matter of jurisdiction, most of this mining region being in the national forest, and to a certain extent under federal control.

At Happy Camp local miners think that large yardages of gravel left behind by former hydraulic operators can now be worked at a

Vol 31

1935

profit with gold at $35 per ounce. A good water-right is said to be available on Elk Creek with the building of 12 miles of ditches and flume. This water could be used to work the Richardson, Knownothing, Collins, Reeve, Little Crumpton, Davis and other properties.

Salmon River District.

This district has been the most productive, and remains the most active and important gold mining area of the county. It embraces the drainage of Salmon River, an area of about 800 square miles, including many formerly productive quartz mines and placer deposits, the latter exploited in later years almost entirely by the hydraulic process. Considerable quartz prospecting is going on, and there is also a revival of hydraulic mining, which for several years had been hampered by shortage of water.

The principal mining camps of the district are Sawyers Bar, on the North Fork of Salmon River 55 miles by road from the railroad at Gazelle, and the same distance from Yreka, the county seat; and Forks of Salmon, at the junction of the north and south forks of Salmon River, 17 miles by road west of Sawyers Bar. Between Etna and Sawyers Bar, a distance of 25 miles, the road passes over the Salmon Mountains at an elevation of 5929 feet, and the heavy snowfall in normal years prevents travel by automobiles into the district during about four months of winter. A road along Salmon River from Forks of Salmon connects with the Klamath River road at Somes Bar, and gives this district an outlet to the coast system of highways via Orleans. The more important placer mining operations are confined to the benches, back channels and bars of the North Fork of Salmon River between Sawyers Bar and Forks of Salmon, and to Eddys Gulch, a tributary of north fork entering it from the south at Sawyers Bar. There are also unworked placer deposits in Whites Gulch, a tributary of north fork entering it three miles east of Sawyers Bar; on the south fork in the vicinity of Cecilville and Forks of Salmon, on the main river down stream from the latter camp and some small areas on the tributaries near the main branches of the river.

There are only two or three small areas of a few acres each of arable land along Salmon River, the balance of the district being an elevated mountain region, deeply dissected by the streams whose beds lie from 2000 to 4500 feet below the surrounding summits, so that the traveler is constantly climbing.

There is a good supply of timber for all mining purposes in this district. Water is available in the numerous creeks and gulches and in the Salmon River, in quantity ample for hydraulic and quartz mining, and in some places under conditions favoring hydro-electric power installations. The possession of these natural resources, and an exceptionally healthful climate, help to discount the remoteness of the district. The main North Fork of Salmon River has a grade of about 51 feet per mile from Sawyers Bar to Forks of Salmon, and the south fork 40 feet per mile.

The placers of the North Fork of Salmon River, in a distance of 17 miles between Sawyers Bar and Forks of Salmon have made an estimated production of $25,000,000 in gold. The sources of this were the numerous gold-bearing veins of the basin drained by Salmon River and its tributaries, most important of which were the last two named gulches, Russian Creek, and the south fork below the mouth of Black Bear Creek.

Quartz mining and prospecting have been very active in the Salmon River District, during 1934 and 1935, particularly in the vicinity of Sawyers Bar and Cecilville. Substantial production has been made by the King Solomon Mines Co. and Gold Ball Mining Co., and some production by Norcal Mining Co. and Mayland Mining Co. The Jumbo, Keaton, Hickey and other properties are being prospected. Further details on these mines are given below. Additional production will probably soon be made as a result of this activity. These mines are associated with a belt of slaty schists (closely similar to the Calaveras slates of the Mother Lode country) and other schists derived from both sedimentary and igneous rocks. Other igneous rocks, now considerably altered, intrude these schists.

Elliott Creek District.

This district is on the north side of the Siskiyou Mountains, the creek being a tributary of Applegate River. The principal property is the Blue Ledge Copper Mine, claims of wrich extend through the north-central part of T. 47 N., R. 11 W., and the south-central part of T. 48 N., R. 11 W. There are some other copper claims in the district. A number of the placer mines along Elliott Creek are described in State Mineralogist's Report XXVII,* copies of which are still available at offices of this division. Hence those descriptions will not be repeated here. The region is reached from Jacksonville, Oregon, 33 miles northeast.

Bullion Mountain District.

Prospecting is quite active in this district, and there is some small-scale production. In the properties visited, the veins follow one or both walls of basic dikes intruded into diorite. Mines include the Golden Rule, Lumgrey, Blue Jay, Trust Buster, Corbett, Bowser, Central and Iron Dike. Descriptions of the three last named are given below under 'Gold Mines'.

Other Minerals.

Among the minerals found in this county, and mentioned in this report besides gold, are asbestos, californite, chromite, coal, copper, lead, limestone, manganese, marble, molybdenite, platinum group metals, pumice, quicksilver, sandstone and miscellaneous stone. There are also numerous mineral springs. At present, production of other minerals is small as compared to the production of gold. A number of the gold mines and other deposits of Siskiyou County were described in State Mineralogist's Report XXVII,* chapter for January, 1931. Only the more active of these were visited again during the field-work for the present report. Descriptions of some of the deposits are repeated here to make the report more complete; also parts of descriptions of deposits of other minerals from State Mineralogist's Report XXI**, chapter for October, 1925, now out of print. Most of the gold mines described below were visited late in 1934, or early in 1935.

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* Averill, C. V., Preliminary Report on Economic Geology of the Shasta Quadrangle, Mining in California, January, 1931, pp. 56, 57.

** Logan, C. A., *op. cit.*

MINERAL PRODUCTION OF

Year	Gold, value	Silver, value	Chromite		Mineral water	
			Tons	Value	Gallons	Value
1880	$440,735	$95,340	----------	----------	----------	----------
1881	850,000	1,500	----------	----------	----------	----------
1882	720,000	----------	----------	----------	----------	----------
1883	400,000	----------	----------	----------	----------	----------
1884	475,000	----------	----------	----------	----------	----------
1885	338,659	----------	----------	----------	----------	----------
1886	342,677	64	----------	----------	----------	----------
1887	606,859	177	----------	----------	----------	----------
1888	625,000	----------	----------	----------	----------	----------
1889	915,294	370	----------	----------	----------	----------
1890	860,303	23	----------	----------	----------	----------
1891	957,220	120	----------	----------	----------	----------
1892	1,013,332	56	----------	----------	----------	----------
1893	799,108	----------	----------	----------	----------	----------
1894	760,782	----------	----------	----------	----------	----------
1895	950,006	177	----------	----------	200,000	$80,800
1896	1,091,265	653	----------	----------	[3]	----------
1897	842,123	34	----------	----------	[3]	----------
1898	768,804	321	----------	----------	[3]	----------
1899	991,771	100	----------	----------	[3]	----------
1900	951,397	[2]6,700	----------	----------	700,000	45,000
1901	886,043	[2]2,980	----------	----------	700,000	175,000
1902	906,989	233	----------	----------	750,000	187,500
1903	613,576	22	----------	----------	750,000	50,000
1904	892,685	1,230	----------	----------	750,000	50,000
1905	803,035	2,499	----------	----------	[3]	----------
1906	[3]	[3]	----------	----------	[3]	----------
1907	398,017	3,037	----------	----------	725,000	36,250
1908	504,156	6,125	----------	----------	700,000	80,000
1909	416,160	2,145	----------	----------	500,000	10,000
1910	437,376	2,322	----------	----------	500,000	60,000
1911	422,297	2,561	----------	----------	700,000	120,000
1912	472,314	2,980	220	$2,310	700,000	120,000
1913	[4]180,125	[4]1,228	----------	----------	700,000	120,000
1914	312,842	1,026	----------	----------	650,000	65,000
1915	426,716	2,081	[3]	----------	626,680	62,990
1916	441,307	2,312	2,251	28,731	502,650	50,530
1917	325,550	16,883	2,046	49,797	503,000	50,600
1918	294,227	14,501	6,612	336,588	501,750	50,175
1919	226,525	17,049	510	13,379	451,500	90,375
1920	80,707	5,218	215	5,732	300,150	60,015
1921	42,635	294	[3]	----------	250,150	5,015
1922	75,105	612	----------	----------	----------	----------
1923	45,633	298	----------	----------	200,150	4,042
1924	63,570	296	----------	----------	----------	6,100

SISKIYOU COUNTY, 1880–1934

Platinum group metals		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Ounces	Value		Amount	Value	Substance
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
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----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
100	$600	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	
----------	----------	----------	----------	$1,202,742	Unapportioned, 1900-1909
----------	----------	----------	----------	----------	
----------	----------	----------	200 lbs.	23	Copper
----------	----------	----------	----------	----------	
1.6	21	----------	----------	----------	
5.3	93	----------	2,500 cu. ft.	1,250	Sandstone.
----------	----------	----------	2,500 cu. ft.	1,500	Sandstone.
----------	----------	$39,000	193 lbs.	39	Copper.
			2,643 lbs.	140	Lead.
			11,433 cu.ft.	12,897	Sandstone.
			1,000 bbls.	1,000	Lime.
			220 tons	300	Limestone.
			4,949 lbs.	1,183	Lead.
----------	----------	----------	1,800 cu. ft.	1,485	Sandstone.
			1,090 lbs.	1,680	Lime.
----------	----------	5,028	3,360 lbs.	144	Lead.
			50 tons	500	Pumice.
			1,050 cu. ft.	1,750	Sandstone.
			100 bbls.	300	Lime.
			2,225 tons	2,200	Limestone.
			----------	14,745	Gems.
----------	----------	9,475	1,204 cu. ft.	2,000	Sandstone.
			335 bbls.	735	Lime.
			35 tons	525	Limestone.
			----------	1,000	Gems.
----------	----------	6,580	150 bbls.	120	Lime.
			24 tons	24	Limestone.
			650 cu. ft.	455	Sandstone.
----------	----------	609	250 cu. ft.	250	Sandstone.
			----------	250	Gems.
----------	----------	4,883	----------	250	Gems.
			90 tons	2,000	Pumice.
			----------	1,500	Other minerals.
9	304	5,371	100 tons	500	Coal.
			58 lbs.	2	Lead.
			677 bbls.	629	Lime.
			250 cu. ft.	150	Sandstone.
----------	----------	4,630	188 lbs.	9	Lead.
			745 bbls.	745	Lime.
			----------	16,923	Chromite, copper, marble, sandstone.
[3]	----------	45,407	----------	12,609	Copper, building stone, lime, platinum, sandstone
15	709	134,382	----------	500	Granite.
			888,043 lbs.	242,436	Copper.
			192 lbs.	17	Lead.
			----------	8,535	Lime, sandstone, soda.
1	58	24,588	573,593 lbs.	141,677	Copper.
			----------	15,473	Lead and pumice.
7	1,015	26,405	----------	111,294	Copper, limestone, pumice, quicksilver.
----------	----------	30,322	----------	47,121	Copper, lime, limestone, potash, pumice, quicksilver.
[3]	----------	44,343	----------	1,060	Asbestos, brick, chromite, lime, platinum.
----------	----------	21,726	----------	4,020	Other minerals.[5]
3	339	129,291	----------	1,408	Other minerals.[6]
----------	----------	67,787	----------	3,034	Other minerals.[7]

MINERAL PRODUCTION OF

Year	Gold, value	Silver, value	Chromite		Mineral water	
			Tons	Value	Gallons	Value
1925	$180,120	$831			[3]	
1926	141,240	709			[3]	
1927	138,822	586			[3]	
1928	85,717	421			[3]	
1929	63,843	863			[3]	
1930	70,332	4,172			[3]	
1931	74,326	169			[3]	
1932	133,115	304			[3]	
1933	324,954	686			[3]	
1934	528,395	1,861			[3]	
Totals	$26,708,789	$204,169	11,854	$436,537	[3]12,361,030	$1,579,392

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[1] Includes crushed rock, rubble, rip-rap, sand, gravel.
[2] Recalculated to 'commercial,' from 'coining value' as originally published.
[3] See under 'Unapportioned.'
[4] Production from dredging operations included in Stanislaus County production.

ASBESTOS

There are many large areas of serpentine, in which some prospects of asbestos occur and others may be expected, in this county. Most of these are too far from railroad for present consideration. Among the remote, unprospected areas may be mentioned the dikes and larger bodies of the rock which occur in the western part of the county, beginning six miles north of Orleans, thence recurring frequently along both sides of Klamath River for many miles, and along the west side of the county to the Oregon line, as well as eastward along Salmon River from Somes Bar at intervals as far as Methodist Creek; near Hamburg Bar, north of Klamath River; near Scott Bar and in the Callahan district. Among the serpentine areas within reasonable distance of the railroad are the mountainous area adjacent to the highway between Yreka and Fort Jones, and areas near Yreka, near Montague in Shasta Valley, and near Gazelle and Dunsmuir.

Burns Ranch. Owner, W. L. Burns, Gazelle. Patented land in Sec. 16, T. 42 N., R. 6 W., four miles west of Gazelle.

A little shallow work has been done on a chrysotile asbestos prospect, showing fiber up to 1¼ inches in length, but brittle. The quality might improve with depth.

C. C. Cady Asbestos Prospect on Greenhorn Mountain, between Yreka and Fort Jones, was leased in 1923 to Geo. Souza who did some work. The surface showing of asbestos here can be traced for a considerable distance.

Geo. W. Conrod, P. O. Box 577, Weed, sent in to the Bureau late in 1925, samples of slip-fiber (amphibole) asbestos. Locality not stated.

H. Johnson of Sisson has seven locations for absestos on Eddy Mountain, southwest of Weed and near the Trinity County line.

J. J. Murray of Yreka several years ago located asbestos claims near the head of Seiad Creek, on a steep mountain four to five miles

SISKIYOU COUNTY, 1880-1934—Continued

Platinum group metals		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
Ounces	Value		Amount	Value	Substance
				$3,535	Lime and limestone.
3		$23,800		11,340	Mineral water, platinum, sandstone.
16	$1,780	327,569		22,853	Coal, lead, mineral water, sandstone.
10	690	102,428		56,420	Mineral water, sandstone.
		370,833		14,195	Copper, lead, gems (rhodonite), mineral water.
		110,878		54,205	Copper, lead, limestone, quicksilver, mineral water.
		85,851		75,046	Copper, lead, granite, mineral water, gems, platinum, quicksilver, lime, pumice.
		79,772		32,740	Other minerals.
		23,415		27,185	Lead, quicksilver, mineral water.
		29,036		19,502	Copper, lead, mineral water, pumice.
		67,216		50,694	Copper, lead, mineral water, pumice, tube mill pebbles.
167.9	$5,609	$1,780,625		$2,228,844	

[5] Includes limestone and mineral water.
[6] Includes lead and lime.
[7] Includes coal, limestone, lime and platinum.

from the end of the wagon road, north of Seiad P. O. and nearly 70 miles from the railroad. Idle.

Shasta View Asbestos Prospect. Owner, W. S. Russell, Edgewood. In Sec. 8, T. 41 N., R. 5 W. Contains 12 unpatented claims, reached by three miles of good road from Edgewood. Elevation 4000 feet. There is plenty timber and water. Electric power is three miles distant.

Chrysotile asbestos occurs here and in 1921 a production of a small quantity of short fiber chrysotile was made. It was stated this carried 25% of fiber. Samples from the property show fully that percentage of fiber, one-half inch and less in length. There is some fiber one inch long.

National Cement Company of Modesto did some work in 1921–22 on the property, but it later reverted to Russell and is idle, except for assessment work. Development consists of short open cuts, not over 16 feet deep.

CHROMITE

Considerable chromite was produced in this county during the war, and some of the remoter districts were just getting into production when the armistice was signed.

At the height of the war minerals 'boom' in 1918 the State Mining Bureau published a book of 248 pages, designated as Bulletin 76, "Manganese and Chromium in California," in which were listed and described practically all the then known deposits of these minerals in the state, and this book is still available at fifty cents a copy. As there has been no market worth mentioning for chromite from this state since 1918, except small lots of high-grade ore from properties nearby the railroad, there appears to be no occasion for extensive field work in this connection. The main facts regarding chromite properties in the county are given in the synopsis following.

Attention should be called to the fact that since 1918 the Klamath River road has been made passable for trucks the entire distance from Hornbrook on the railroad to Somes Bar in the southwest corner of the county, where connection is made with the coast highways via Orleans. This opens up the large and only partly prospected areas of serpentine near the road, and is an outlet for the remoter areas west and northwest of the river to Del Norte County on the west and the Oregon state line on the north. This district was promising to be a big producer of chromite when the market failed, but the cost of hauling would be very heavy, as Happy Camp is 76 miles from Hornbrook.

The districts from which chromite production has been made in the county are: Callahan, Etna Mills, Fort Jones, Scott Bar, Yreka, Gazelle, Hamburg Bar, and Dunsmuir. In addition to these, and the others mentioned previously, there are other serpentine and peridotite areas (listed under Asbestos) not so far productive.

The production of individual properties was in few cases over 500 tons, the largest producer being the Coggins deposit, three miles south of west from Dunsmuir, where the ore contained 38% to 40% Cr_2O_3. The highest grade ore came from the Callahan district, where claims were 30 to 50 miles from Gazelle, the nearest shipping point. A large property near Hamburg Bar is about 48 miles from Hornbrook, and as it lies on the north side of Klamath River would require a bridge or tramway.

Besides the above localities, the following deposits have come to our attention since 1918, in addition to those listed in the tabulation of properties taken from our Bulletin 76:

Chromite King—see Peg Leg.

Furlong Bros. and T. A. Lloyd have been prospecting lenses of chromite with small open cuts in T. 41 N., R. 7 W., one to three miles south of the point where the road from Gazelle to Callahan crosses the summit.

H. Johnson of Sisson reports having a large tonnage of chromite six miles from the railroad, and within two miles of an old road.

Milne and Reichman Deposit. Owners, Geo. Milne and G. A. Reichman, Fort Jones. This is a large disseminated deposit of chromite 1¼ miles from the Scott Bar road, 44 miles west of Yreka. The chromite occurs in seams and high grade ore must be sorted. The average is low grade. Six hundred tons have been mined, and most of it hauled to Yreka. Idle since 1919.

Mountain Chrome Mine. Owners, W. D. and N. Dale, address W. D. Dale, 2668 Fourth Avenue, Sacramento. This is seven miles southwest of Edgewood, in Sec. 24, T. 41 N., R. 6 W., near North Fork of Shasta River. The owners state that 100 tons of ore have been mined and that they have crosscut the ledge for 80 feet without striking the other wall.

Peg Leg Mine. Former owners, W. P. Johnson, N. Lambert and Mrs. F. A. Shebley. Address N. Lambert, Fort Jones. This is 14 miles southwest of Yreka via road to Fort Jones, and near Moffit Creek. High grade chromite, containing 50% Cr_2O_3 was mined in 1918 and

1919. Ninety tons was shipped, an equal amount was on hand and the prospects were good for opening a larger body in the lower tunnel when visited by a Bureau representative in July, 1919.

Walter E. Brown and Major H. A. White of Yreka are holding seven claims to cover this deposit. A few tons of high-grade chromite were piled on the dump at the lower adit, which was partly caved when the property was visited in July, 1935. The name has been changed to *Chromite King.*

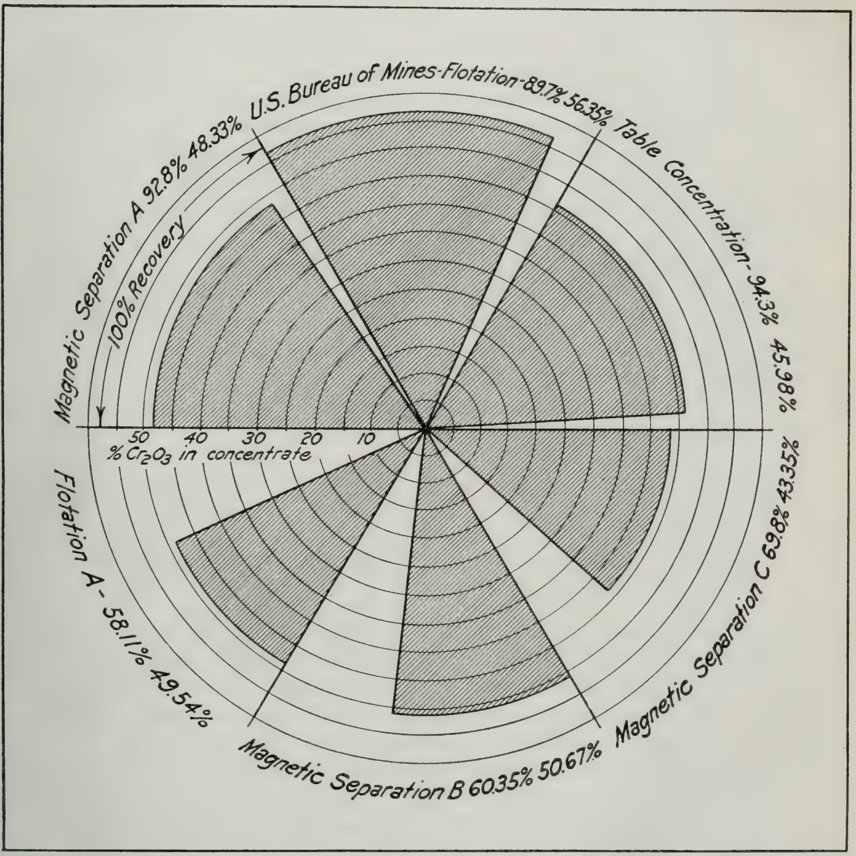

Fig. 1. Seiad Creek Chrome Deposits. Results of metallurgical tests made for H. W. Gould and J. H. Hines, in percentage of recovery and percentage of Cr_2O_3 in concentrate, by six different methods.

Seiad Creek Chrome Deposit in Sec. 20, T. 47 N, R. 11 W., is held by H. W. Gould, Mills Building, San Francisco, and is under option to J. H. Hines, Goodwyn Institute Building, Memphis, Tennessee. The total distance from the railroad at Hornbrook is 58 miles, 27 miles paved and oiled road down Klamath River, then 24 miles gravel and dirt road to Seiad, then seven miles mountain road up Seiad Creek, and 1000 ft. steep sled-road to mine. The deposit is on a ridge between two forks of Seiad Creek, each of which flows a good stream of water the year round; and the country is well timbered.

LeRoy A. Davis of Seiad, and Cyrus B. Crawford originally located three claims (about 1916), and Gould added four additional locations in 1933. During the war several thousand tons of hand-sorted chromite running 48% were shipped, part of it by the late Dr. Reddy of Medford, Oregon, who held a lease on the property.

The deposit is more vein-like than the lenses of chromite usually found. The chromite occurs as veins and veinlets following the schistosity of a schist (or gneiss) apparently formed from a basic igneous rock. An occasional vein is 2 ft. to 3 ft. wide, and has the lenticular form commonly found. In addition to these there are thousands of tons of schist containing veins and veinlets of chromite varying from a fraction of an inch to an inch in width. Gould has made estimates of 1,000,000 tons to 2,000,000 tons of ore that will concentrate to 500,000 tons of product assaying 50% Cr_2O_3, assuming a minable width of 35 ft., length 1800 ft. to 2000 ft. and depth 250 ft. These figures give a good idea of the appearance of the deposit; but additional development work will be required to actually prove the tonnages mentioned.

Development work consists of some 30 surface cuts, the largest of which, 125 ft. by 40 ft., produced most of the ore shipped during the war, and 600 ft. of underground work in two adits. The latter have been driven into both sides of the ridge between the two forks of the creek, and comprise 200 ft. of crosscutting and 400 ft. of drifting. The following analysis of the chromite was made for Gould by Abbot A. Hanks of San Francisco:

Cr_2O_3	46.39%
FeO	16.87%
SiO_2	8.54%
Al_2O_3	10.30%
MgO	16.22%
CaO	1.40%

This indicates a ratio of chromium to iron that is higher than usual, which is an advantage in making a high-grade concentrate.

The accompanying diagram (Fig. 1) shows the results of experimental work done on the metallurgy, which is described in greater detail in a report by Gordon I. Gould, dated Feb. 20, 1934. In both table concentration and magnetic concentration, difficulty is experienced with the fine sizes that are unavoidably made in crushing and grinding. Good results can be obtained by both methods on sized material of about 40-mesh size; but results are poor on the 50% of finer sizes that would be made. Much of the gangue is olivine, which approaches the specific gravity of chromite more closely than other gangues. On a concentrating table, the finer sizes of this are trapped in the concentrate. Three separate and distinct types of magnetic separator were used with the results indicated in the diagram. The magnetic permeability of chromite (particularly this chromite with its low iron content) is low, and the gangue has a slight permeability. In the finest sizes, this effect together with molecular attraction and dusting makes separation difficult. Best results were obtained by the Mississippi Valley Experiment Station of the U. S. Bureau of Mines, Rolla, Missouri, using floatation. The only details available on the method used are given below: An acid circuit was used on account of the olivine-gangue. Ore tested assayed 32.17% chromite (Cr_2O_3).

Product	Weight (%)	Assay per cent Cr_2O_3	Per cent of the Cr_2O_3
Concentrate	46.3	57.76	83.1
Middling	13.2	22.88	9.4
Tailing	40.5	5.95	7.5

In the above test rougher concentrate assaying 50.02% Cr_2O_3 was cleaned twice, but one cleaner produced concentrate that assayed 56.35% Cr_2O_3 that represented a recovery of 89.7%. The chromite was floated in this test. Other tests were made on floating the gangue with good results, but not as good as those given above.

Several mining claims on a chromite deposit in Sec. 30, T. 45 N., R. 10 W., on McGuffy Creek, a tributary of Scott River, are held by H. W. Gould also. They are under option to J. H. Hines.

Other properties mentioned in Bulletin 76 are tabulated below:

Name of property	*Section, township and range*	*Length of haul, railroad shipping point*
Ball Ranch	16–41– 9	26 miles Yreka
Burns Ranch	16–42– 6	4 miles Gazelle
Butcher Ranch	--------	1 mile Yreka
Coggins	--------	3 miles Dunsmuir
Chastain	--------	--------------------
Cramer	22–44– 8	14 miles Yreka
Hamburg Bar	15–46–11 22–46–11 23–46–11	48 miles Hornbrook
Davis	10–39– 9	38 miles Gazelle
Dexter Ranch	--------	4 miles Montague
Facey	--------	--------------------
Flederman	10–41– 9	28 miles Yreka
Flederman Lease	--–43– 8	15 miles Yreka
Grant Lease	25–42– 9	14 miles Yreka
Grouse Creek	13–40– 8 19–40– 7	25 miles Gazelle
Le May	--–44– 7	--------------------
Martin-McKeen	34–40– 9	36 miles Gazelle
Masterson	14–40– 8	Gazelle
McCarthy	--------	32 and 42 miles Yreka
Musgrave	--------	--------------------
Souza Ranch	--------	1 mile Yreka
Sugar Creek	--------	40 miles Gazelle
The Chrome Mine	12–39– 9	36 miles Gazelle
Valine Ranch	--------	1½ miles Yreka
Wilson Ranch	--------	20 miles Yreka
Wurst	--------	35 miles Gazelle

At the time the chromite market collapsed, Siskiyou County was regarded as one of the largest prospective producers of the mineral in the United States, and it was estimated that the production in the next year would be 30,000 tons or more, mostly from the Klamath River deposits, located from Hamburg Bar westward.

COAL

Lignite and sub-bituminous coal occur in Siskiyou County in Shasta Valley. Probably several thousand acres in this valley are underlain by coal.

Ager Coal Mine is on the Hagedorn Ranch, five miles south of Ager. Henry Hagedorn, owner. Years ago a slope 700 feet long on an incline of about 15° was sunk on the coal, which occurs between layers of hard shale, with alternating beds of hard sandstone above and below. The area has been mapped by Professor J. P. Smith* as Tertiary. The normal dip of the strata is about 23° east, but in this vicinity the sedimentary beds have been broken by a series of basaltic intrusions, indicated by a line of low hills running in a southeasterly direction. The dip of the beds increases to 40° NE. near this line. From the incline three drifts were run north a maximum distance of 500 feet, and three drifts south, the longest 400 feet, on the coal. A width of six feet carries coal, but the best, solid part of coal varies from 14 inches up to four feet, and is said to average two feet. The walls stood well without timbering. Five thousand tons or more have been produced and some of it sold. The last active work was in 1914–15 by Yreka Development Company, then lessee.

Numerous prospect holes have been drilled in the same vicinity on the *Hagedorn, Herr, Cooley* and *Denny Ranches.*

On the *Cooley Ranch* a hole 130 feet deep is said to have struck 11 feet of coal at a depth of 118 feet. Another hole 106 feet deep is said to have struck 20 inches of coal at a depth of 95 feet.

Siskiyou Coal and Coke Company. R. D. Clark, President, Yreka. Leverett Davis, Mining Engineer. This company had leases on parts of ranches in Shasta Valley where coal has been found, as mentioned. In September, 1925, the company was putting down a diamond drill hole on the Herr Ranch, one-fourth mile north of the 106-foot hole mentioned above. The hole was down 110 feet and had not struck coal, which was not expected until a depth of over 200 feet. The core of the hole at time of visit showed alternating layers of sandstone and shale. The sandstone was most abundant, and some of it is quite hard. The coal dips NE. 40° according to C. B. Kay, the steeper dip being on account of the proximity to the line of basalt intrusives. The company reports tests on the coal where previously opened indicating coking possibilities, but a classification as bituminous coal.

In the southeastern part of the county, in townships 39 and 40 north, ranges 1 west and 1 east, there occur outcrops of sedimentary rocks, forming the northern part of an area of Triassic and Tertiary sediments which extend north and east from near Redding. Just south of the Siskiyou County line in Shasta County some coal prospects have been noted in this area in Tertiary formations, but are not known to extend into Siskiyou County.

There is a possibility of coal being found at the proper horizon anywhere in the Tertiary beds which are exposed from the Oregon line southward to five miles south of Ager, having a maximum width of eight or nine miles in townships 47 and 48 north, ranges 5 and 6 west, M. D. M. Such an occurrence is found on the James O. McMaster Ranch in the Hornbrook district, where nine feet of shale is intershot with small streaks and spots of soft coal, and there is also a seam up to two inches thick of what McMaster describes as ''good hard coal, making a hot fire with a blue-green gaseous flame.''

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* Cal. State Min. Bur. Geologic Map of Cal., 1916.

COPPER

Very little progress has been made in the county in copper mining the past 10 years. After the price of copper fell, following the war, there was little incentive for the copper miners of Siskiyou County to produce ore, and since 1920 practically only necessary assessment work has been done. Little field work was done, therefore, among the copper mines and prospects for this report, and the following notes are a compilation of past reports, scattered among various publications in the past, but gathered here for readier reference; also a list of newer prospects.

Siskiyou County apparently contains some of the best unworked copper deposits in the state. The two most promising districts are near Happy Camp in the western part of the county, and near the northern county line on the headwaters of Applegate River. The two principal proved properties are the Grey Eagle near Happy Camp, and the Blue Ledge in the Elliott Creek district. There are numerous copper prospects throughout both the western and northern parts of the county, where gossan outcrops occur and have been slightly prospected, but not sufficiently to definitely indicate their possibilities.

The greatest hindrance to development of this branch of mining is the remoteness of the region from railroads. Happy Camp is 76 miles from railroad and most of the copper prospects are still farther away. From time to time there is talk of a railroad being built from the vicinity of Hornbrook down the Klamath River. Due to the districts being in the national forest the federal government would not permit operation of a smelter.

Bulletin 50 of the California State Mining Bureau lists 45 prospects of copper in this county. This bulletin was published in 1908. Since that time, the Blue Ledge and Grey Eagle properties have been extensively developed and proved to contain considerable ore. Little has been done with the others. The principal production of copper occurred in 1917 and 1918, when about 1,460,000 pounds were sold. Developments in the past few years have served to emphasize the widespread distribution of copper prospects.

Ames Prospect. Owner, A. Ames, Happy Camp. One claim on a gossan outcrop on the southwest slope of Clear Creek Canyon, eight miles by road and three miles by trail from Happy Camp. Only assessment work is being done.

Barton Claims. Owner, H. J. Barton, Yreka. Claims on Horse Creek, nine miles upstream from the mouth. Formerly known as the Hetchell prospect. Contains four claims. Idle.

Barnum Brothers Copper Prospect. (*Copper Mountain Group.*) Owners, Barnum Bros. et al. This group comprises 19 claims on Sambo Creek in Oak Bar district. It was equipped with a compressor and air drills in 1919 and in 1925 was under lease to Williams of Yreka, who was continuing an adit. Several hundred feet of underground work has been done.

Blue Ledge Mine. Owner, Towne Mines, Inc., 120 Broadway, New York City. This property comprises 26 patented claims in T. 47 and 48 N., R. 11 W., in Elliott Creek district, at an elevation of about 5000 feet. Jacksonville, Oregon, is the nearest town and is 33 miles northeast.

The footwall of deposit is grey to black micaceous schist and the hanging wall is a white mica schist. The vein strikes nearly north, dips 60° west and averages 5 feet wide, though reaching a maximum width of 35 feet. A pay shoot 1500 feet long and 5 feet wide is reported proven by a series of adits and drifts which have developed the vein for a length of 1800 feet and a depth of 600 feet. In 1920 the management estimated that there were 240,000 tons of ore blocked out, having an average content of 4.8% copper, .035 oz. gold and 1.5 oz. silver. It is essentially chalcopyrite, and pyrite, the iron content going as high as 32%. The mine was operated up to the latter part of 1920 but has been idle since. Nearly 9000 tons of sorted ore was shipped. It contained an average of 13.7% copper, 5.5 oz. silver, .1 oz. gold, 30% iron and 30% sulphur. Steam was used for power, wood fuel from the claims being utilized. There are a compressor, air drills and underground hoist.

Bibl: Cal. State Min. Bur. Bull. 50, p. 123. R. XIV, p. 817; XVII, p. 530.

Buzzard Mine. See under gold quartz mines. The ore exposed in the mine workings immediately under the oxidized ore is a heavy sulphide, mostly pyrite, with a small amount of copper.

Clear Creek Mine. (*Davis Mine.*) Owners, Estate of Reeves Davis et al. It is on Clear Creek, 13 miles southwest of Happy Camp. It has been quite extensively prospected, and gave an encouraging showing, but it is said that a good sized orebody could not be found in place. *See Paradise,* under Gold.

Dillon Creek Prospects. In the summer of 1917, following a forest fire which cleared off the brush, eleven copper claims were located in the vicinity of the headwaters of Dillon Creek, which enters the Klamath from the northwest near Cottage Grove. Later the Grey Eagle Copper Co. did some prospecting in this vicinity, but the result of this is not known. The original locators of the claims were: Jettie Albars, Jack Davis, Swaney Peters, Wm. Elliott, Chas. and M. Thomas; Henry, Mrs. J. C. and Mrs. J. Aubrey, all residents of the Blue Nose and Somes Bar districts.

Efman & Boorse Prospect. Owners, Mike Efman and H. G. Boorse, Happy Camp. This is an undeveloped claim on a gossan outcrop in Elk Creek Canyon, two miles south of Happy Camp. Only assessment work was being done in 1925.

Gray Eagle Mine. Owner, Gray Eagle Copper Co., 14 Wall St., New York City. It comprises 32 claims, mostly patented, in Sec. 4 et al., T. 17 N., R. 6 E., H. M., on mountain on the east side of Indian Creek, north of Happy Camp and 80 miles by road west of Hornbrook, the nearest railroad station. The elevation of main adit, No. 7, is 2539 feet.

The deposit is an ore zone trending southeast, varying in width from 10 to 80 feet, and carrying ore along fracture planes normal to the grey schist country rock. The ore is principally chalcopyrite, carrying an average of 6% copper. The sulphide ore is covered by a gossan cap. No. 7 adit has been run about 3000 feet southeasterly and a total of about 10,000 feet of underground work is reported from this adit. Ore exposed on this level is said to be mostly pyrite, but where raises have been put up good ore has been exposed, as was also the case in the upper adits. Over 1,000,000 tons of ore are claimed to have been blocked out. The mine is equipped with a steam plant, large compressor, electric light plant, shops and buildings. Water is taken from nearby branches of Indian Creek. There were 60 men employed between 1916 and 1918, since when the mine has been idle.

Bibl: Cal. State Min. Bur. Bull. 50, p. 132. R. XIV, p. 818; XVII, pp. 531–532.

Henry Wood, Seiad P. O., has a copper prospect on Beat and Bender Gulch, near the Portuguese Mine, and has been doing some work the past summer.

Isabella Copper Mine. Owner, Isabella Copper Mining Co., c/o Loren W. Smith, 611 Bank of America Bldg., Oakland. This is a prospect containing 120 acres, in Sec. 34, T. 41 N., R. 7 W., 18 miles southwest of Gazelle. The vein is said to carry 'grey copper,' silver and gold. It has been developed by a shallow shaft and several adits. Equipment includes a steam plant, small air compressor and air drill.

Bibl: Cal. State Min. Bur. R. XVII, p. 532; XXVII, p. 28.

Liberty Bond Group. Owner, F. B. McCann, Happy Camp. This comprises 11 claims on a ledge in schist near a limestone contact. The ore is said to carry 1 to 1½% copper and several dollars gold per ton. Only assessment work has been done.

Bibl: Cal. State Min. Bur. P. R. 8, p. 14.

Malone Mine. Owners, Churchill, Roseburg et al. of Yreka. It is in Elk Creek Canyon, 14 miles by trail south of Happy Camp. Some good looking sulphide ore, carrying pyrite and chalcopyrite, has been exhibited from this property. The principal work is an adit 160 feet long.

Parker Group. Owner, Geo. J. Parker, Copper P. O. This comprises six unpatented claims in Sec. 20 or 21, T. 48 N., R. 11 W., in Elliott Creek district. About 200 feet of prospect adits have been run. The owner has been working alone.

Sunshine Group. Owner, W. J. Brown, Happy Camp. It contains two unpatented claims on a copper-bearing outcrop on Cave Mountain, five miles northeast of Happy Camp, three and one-half miles being by trail up the canyon of the creek. An adit has been run 130 feet at an elevation of 2040 feet, and it is expected the vein will be cut by raising 15 feet. Only assessment work is carried on.

Yellow Butte Mine comprising the W. ½ Sec. 25, T. 43 N., R. 4 W., is assessed to C. A. Stephens of Weed. It is 12 miles northeast of Weed by a good road. The deposit consists of quartz veins in diorite, which belongs to the older formations, and apparently formed a mountain, around which flowed the predominant lava of the region. It thus formed an island in these flows. An incline-shaft, said to be about 300 ft. deep, has recently been retimbered for 35 or 40 ft. The dip is 70°. The white quartz is heavily stained by green copper minerals. A section across the caved ground at the collar of the shaft appears as follows: diorite footwall, 6 inches quartz, 3 ft. diorite, 4 inches quartz, 8 ft. diorite, 2 inches quartz, diorite hanging wall. Sorted ore on the dump shows plentiful chalcopyrite and molybdenite; but this kind of ore was not seen in place. Apparently it came from some depth in a part of the shaft not yet cleaned out.

DIATOMACEOUS EARTH

Ed Ewing, Yreka, has written the Bureau that he has 520 acres of land on which diatomaceous earth outcrops. This deposit has not been visited by a Bureau representative, so no particulars are available as to its location or quality.

GOLD MINES

Balfrey Mines comprise 800 acres of patented land, NE. ¼ Sec. 29 and all of Sec. 28, T. 41 N., R. 7 W., 20 miles southwest of Gazelle. They are owned by M. H. Balfrey of Gazelle. A part of this property was described under the name, "Siskiyou Lead Mine," in State Mineralogist's XXVII.* According to Balfrey, there is a silver prospect on this land, also a vein carrying chalcopyrite and gold that has been developed with a 52-ft. shaft.

Big Cliff (Winterings Mine) is a property of 12 unpatented claims in T. 40 N., R. 10 W., 3 miles southeast of Findleys Camp. The claims are owned by Mrs. Margaret Wintering and Mrs. F. H. Osgood, and are optioned to Dr. W. W. Barham of Yreka. Wintering drove 2000 ft. of tunnels, and milled small amounts of high-grade gold ore. The whole mass of the siliceous schist here is said to carry low-grade values in gold; and it is thought that a large enough tonnage of this ore can be developed to pay by working on a large scale. The property has not been visited.

Black Bear Quartz Mine is assessed to R. S. Phippeny, Sawyers Bar. It comprises 70 acres, patented, seven miles by road southwest of Sawyers Bar in T. 39 N., R. 11 W. The production record has been the best for quartz mines of Siskiyou County, about $3,100,000. This mine was visited in 1933 and in August, 1934, but was idle at both times. For references to descriptions of earlier operations, see accompanying table of mines.

Blue Bar Placer comprises 30 acres in Sec. 31, T. 18 N., R. 7 E., held by C. Scott Greening of Happy Camp. It covers about half a mile of bars along the present channel of Indian Creek just below the Classic Hill mine. According to Greening, the gravel averages 15 ft. deep and 200 ft. wide. He says that the flow of water is so great that only a few feet near the surface could be mined in the early days, and that the gravel below is very high in grade.

Blue Eagle and *Black Dike Groups* of 28 unpatented mining claims in Sec. 10, 11, T. 39 N., R. 10 W., on the steep ridge between Six-Mile and Trail Creeks, at an elevation of 6500 to 7000 ft., are held by H. D. Winship and J. W. Preston, 350 Post Street, San Francisco, Geo. F. Bartlett, Bob McLane, T. T. Taylor and Cutler Paige. From the railroad station at Gazelle, the property is 42 miles southwest, Gazelle to Callahan, 28 miles dirt road, then six miles mountain road up the South Fork of Scott River, then eight miles mountain trail. Roughly

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* Averill, C. V., *op. cit.*, pp. 60, 61.

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WALTER W BRADLEY, STATE MINERALOGIST.

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
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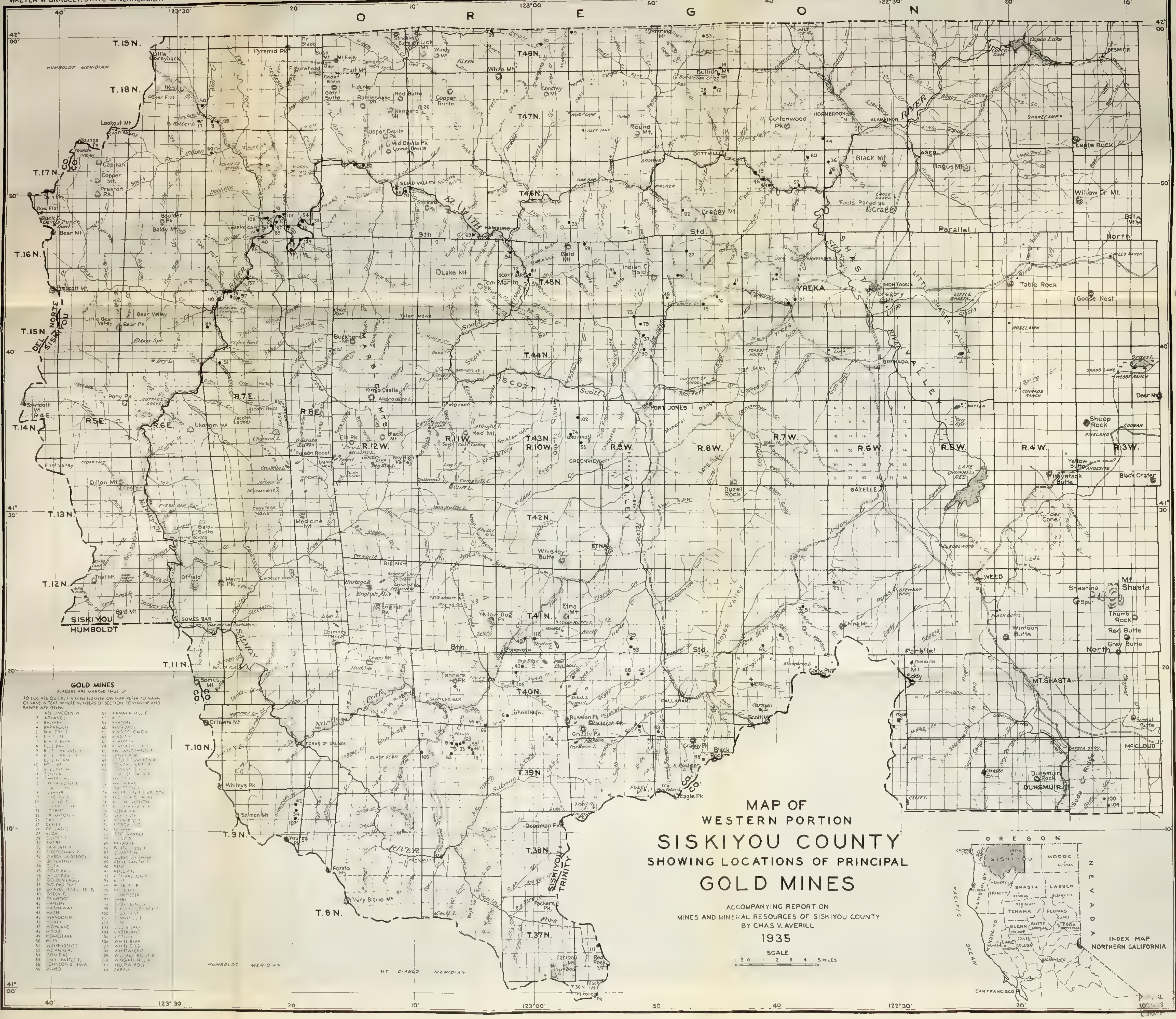
PLATE IV.


O R E G O N
HUMBOLDT MERIDIAN
MT DIABLO MERIDIAN
SISKIYOU
HUMBOLDT
DEL NORTE
TRINITY
KLAMATH RIVER
SCOTT VALLEY
SHASTA VALLEY
YREKA
FORT JONES
ETNA
HAMBURG
MONTAGUE
GAZELLE
WEED
MT. SHASTA
DUNSMUIR
McCLOUD
SOMES BAR
FORKS OF SALMON
SAWYERS BAR
CALLAHAN
HORNBROOK
GOTTVILLE
SCOTT BAR
GREENVIEW
Mt Shasta
9th Std. Parallel North
8th Std. Parallel North
T.19N. T.18N. T.17N. T.16N. T.15N. T.14N. T.13N. T.12N. T.11N. T.10N. T.9N. T.8N.
T.48N. T.47N. T.46N. T.45N. T.44N. T.43N. T.42N. T.41N. T.40N. T.39N. T.38N. T.37N.
R.5E. R.6E. R.7E. R.8E. R.12W. R.11W. R.10W. R.9W. R.8W. R.7W. R.6W. R.5W. R.4W. R.3W.
42° 00'
41° 30'
41° 00'
123°30
123°00
122°30
GOLD MINES
PLACERS ARE MARKED THUS P
TO LOCATE QUICKLY A MINE NUMBER ON MAP REFER TO NAME OF MINE IN TEXT WHERE NUMBERS OF SECTION TOWNSHIP AND RANGE ARE GIVEN
ABE LINCOLN P
2 ADVANCE
4 BARANDUN
5 BEAR CREEK P
7 BLACK BEAR
8 BLUE BAR P
22 CORBETT
23 CRAMPTON P
24 DAY P
25 DEWEY
26 DC LAGITE
27 ELIZA
28 ELLIOTT P
29 EMPIRE
32 GARDELLA DREDGE P
34 GILTA
35 GOLD BALL
36 GOLD BUG
37 GOLDEN EAGLE
38 GOLDEN RULE
39 GRAVEL MINES P
40 GREEN P
41 GUMBOOT
42 HANSEN
43 HATHAWAY
44 HAZEL
45 HERNDON P
47 HIGHLAND
48 HI YOU
49 HOMESTAKE
50 HUEY
51 INDEPENDENCE
53 IRON DIKE
54 JIMS SEATTLE P
55 JOHNSON & LEWIS
56 JUMBO
57 KANAKA HILL P
59 KEATON
60 KING JADE
62 KING TUT
76 MOUNT VERNON
78 NEBRASKA
79 NEW YORK
85 PARADISE
87 QUARTZ HILL
88 QUEEN OF SHEBA
89 REEVE RANCH P
90 RENO
91 RENCAN
92 RICHARDSON P
97 SHEBA
102 TURK
104 UNDERLAND
106 WHITE BEAR
107 WHITE DOG
108 WHITTAKER P
111 YELLOW ROSE
112 ZARINA
INDEX MAP NORTHERN CALIFORNIA
O R E G O N
NEVADA
PACIFIC OCEAN
SISKIYOU
MODOC
DEL NORTE
HUMBOLDT
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
MENDOCINO
GLENN
BUTTE
SIERRA
LAKE
COLUSA
SAN FRANCISCO
SCALE
0 1 2 3 4 5 MILES

MAP OF
WESTERN PORTION
SISKIYOU COUNTY
SHOWING LOCATIONS OF PRINCIPAL
GOLD MINES

ACCOMPANYING REPORT ON
MINES AND MINERAL RESOURCES OF SISKIYOU COUNTY
BY CHAS V. AVERILL.
1935

200 ft. of adits were run here 60 or 70 years ago by King and Ault, and some production of gold was made.

The deposit consists of quartz veins and veinlets in schist of several different kinds. On the ridge above the workings is a graphitic schist similar to that at Sawyer's Bar. At the workings is a contact between a green, chloritic schist and a siliceous schist, in part replaced by white quartz. Nearby is an ingeous intrusion (dioritic?). An adit, 80 ft. long, was run years ago on a stringer zone on the contact between the chloritic schist and the siliceous schist. Recent work in this adit consists of an 18-ft. winze, in which Bartlett states that the quartz stringer zone assays $27 in gold across a width of 3½ ft. This adit is 700 ft. lower in elevation than the top of the ridge, where some open cuts have been made to expose the schist and stringers in place. A lower adit has been run; but it apparently is entirely in the siliceous schist footwall formation. Prospecting is planned to determine whether the entire mass of the schist contains enough gold, including the quartz veins and stringers, to pay for mining on a large scale. This is complicated by a heavy overburden, 4 ft. to 5 ft., of soil and loose broken rock; and it is probable that prospecting will take the form of following the 3½-ft. zone of quartz stringers. Then cross-cuts can be run to explore the schist. One man is prospecting the property.

Blue Gravel Claims (Placer), of 100 acres, are in Sec. 35, 36, T. 17 N., R. 7 E. and Sec. 1, 2, T. 16 N., R. 7 E., and are held by Frank Murree and John Whittaker, Happy Camp. They lie between Cade Creek and Ranch Creek, which flows into the Klamath River at the Reeve Ranch. Prospect cuts show the presence of a terrace here, some 300 ft. higher than the present river. The channel extends through the Crumpton, 200 acres, patented, and the Whittaker, 80 acres, patented, in Sec. 2, adjoining. On the Crumpton, several acres have been mined off, and banks 40 and 50 ft. high remain, from which gold production is said to have been $25,000. A 10-mile ditch from Indian Creek, with outlet 700 ft. higher than Klamath River, has been surveyed to work these properties; but construction has not yet started.

Blue Horn Mine of two unpatented mining claims is owned by R. D. Freshour of Yreka, and is optioned to O. Hauge. It is in Sec. 24, T. 45 N., R. 8 W., four miles due west of Yreka, near the Mt. Vernon mine. A quartz vein in greenstone averages 6 inches in width, with a maximum of a foot. It strikes N. 20° W., and dips 70° W. Development work consists of a 45-ft. shaft, the bottom of which connects with an adit level comprising 25 ft. of crosscutting and 100 ft. of drifting. A second adit connects at the shaft at the 25-ft. level. Drifting and crosscutting on this level total 85 feet.

Vein-quartz is kept separated from the country rock in mining, and it is stated to yield $25 per ton in gold in the mill. Two stamps of 1000 lb. each are driven by an automobile engine. Treatment is amalgamation only. At the time of visit, a rented portable air compressor was in use. Four men were working.

Bowser Mine is in Sec. 11, T. 47 N., R. 8 W., and is reached by mountain road from Hilt. It is owned by the *Buschow Lumber Co.*, Hatfield, Arkansas, and is leased to C. L. Bowser of Hilt. Two quartz veins, each about a foot in width, are separated by a basic dike, 18 inches in width. The strike is east and west, and the dip 60° N. The dike is highly altered, in part to serpentine. On both walls of this combination of veins and dike, the country rock is diorite. A crosscut adit, 167 ft. long, through diorite, reaches the vein; on which roughly 200 ft. of drifting has been done. Work at time of visit was in a small stope, 30 ft. above this level, from which both of the veins and the dike were being mined. Backs to the surface average 100 feet. Small lots of the quartz are treated in a Straub ball mill with a rated capacity of 10 tons per day. It is driven with a 6-hp. gasoline engine. Treatment is amalgamation on plates followed by concentration on a small Wilfley table.

Buzzard Hill Mine, Inc., owns the Buzzard Hill mine of 12 unpatented claims in Secs. 4, 5, T. 15 N., R. 7 E., also the Independence mine, which see. J. E. Merriam, Bedford Hills, New York, is president, and P. M. Tolman, Happy Camp, is superintendent. At the Buzzard Hill, hundreds of feet of development work have been done in gossan ore carrying gold and in the underlying body of heavy pyrite. In 1930, an attempt was made to extract the gold from the gossan with a 3½-ft. Huntington mill using plate-amalgamation. The mine was idle in 1933 and 1934. For additional details on development work see references given in accompanying table of mines. The nearest railroad point is Hornbrook, 80 miles east.

Cal Oro Dredging Co., see Gardella Dredge.

Central Mine in Sec. 2, T. 47 N., R. 8 W., and Sec. 35, T. 48 N., R. 8 W., is owned by C. R. Wiegel of Redding. The mine is reached by mountain road from Hilt. The property includes a 20-acre mining claim, 40 acres patented land adjoining the mining claim, and an 80-acre patented tract covering a spring for water supply.

A quartz vein associated with a basic dike is developed by three adit levels. Country rock is diorite. Dip of the vein is 66°. The No. 1, or highest adit level, has been stoped to the surface and has caved. No. 2 level, 65 ft. below No. 1, comprises 365 ft. of drifting. Wiegel states that there are three ore-shoots on this level, each 30 ft. long and from 3 to 6 ft. in width. No. 3 level is 75 ft. below No. 2, and is 367 ft. long. Wiegel is planning to install a 24-ton ball mill, flotation plant, and air compressor; and he was re-grading roads in order to haul in this machinery at time of visit in June, 1935.

Cherry Hill Mine, in Sec. 27, T. 45 N., R. 8 W., has been described in some detail in State Mineralogist's Report XXVII,* to which the reader is referred. Eleven claims are now held by G. A. Reichman of Fort Jones, and sons, Carl and Fred. Hundreds of feet of drifting and considerable stoping have been done on quartz veins one and two feet wide, with occasional swells to six feet. These workings, which are high on the hill, have been made more accessible with a new road since the last report was written. The 1800-ft. adit at creek level, or 450 ft. lower in elevation than any of the old workings, has been cleaned out. The property is well supplied with water and timber; and a power-line crosses it.

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* Averill, C. V., *op. cit.*, p. 31.

China Point Placer Mine of 40 acres, patented, and 155 acres, unpatented, in Secs. 5, 6, 7, 8, T. 16 N., R. 8 E., near Happy Camp, is held by C. E. Reagan of Happy Camp. Three old drifts on the second channel above the present river, each 100 ft. or more long, are stated to have produced well. The unpatented portion of this property is for the purpose of covering a tunnel-site for a 1400-ft. tunnel, which will drain two miles of river channel. Low bars and river-bed are also covered by this location.

Classic Hill Mine (Placer) of 400 acres, of which 70 acres are patented, is held by C. Scott Greening of Happy Camp. It is in Sec. 36, T. 18 N., R. 6 E., near Indian Creek, 11 miles north of Happy Camp by a good road. About 60 acres of this property were mined off years ago by the hydraulic method with a yield of gold said to be very good. The material mined consisted of the decomposed, oxidized portions near the surface of a network of stringers and seams carrying quartz and free gold. The deposit is associated with a serpentine dike intruded into a series of slates, schist and limestone.

In 1934, an option had been given to Wason and Riley of Seattle, Wash., who were cleaning out the old ditch and repairing the flumes on the lower line, six miles long. Al Hahn was superintendent. Plans called for building a sawmill at the mine as soon as water-power from the lower ditch was available. Lumber was then to be sawed for building flumes on the upper ditch nine miles long. According to Greening, the lower ditch carries 1500 miner's inches, enough to operate three No. 2 giants with 4½-inch nozzles. Head is 140 ft. References to descriptions of earlier operations at this mine will be found in the accompanying table of mines.

Clyburn Placer is a property of 70 acres covering a gravel bar of the Klamath River in Sec. 8, T. 46 N., R. 7 W. It is owned by S. F. Clyburn, and is leased to C. W. Murphee of Kilgore, Texas. Early in 1935, considerable heavy equipment was installed here including a steam shovel, belt conveyor from shovel-pit to washing-machinery on the bank above, trommel 4 ft. in diameter by 15 ft. long, a stacker of linked buckets for coarse tailing, and a sluice for washing undersize from the trommel. Power for the washing-plant was furnished by gasoline engines, and water was pumped from the river with a semi-diesel engine. After the installation was completed, a few cubic yards of gravel were washed; but the plant was idle when visited in June, 1935.

Collins Ranch Placer (Ambrose Mineral Patent) consists of 89 acres in Secs. 6, 7, T. 16 N., R. 8 E., near Happy Camp, held by W. E. Collins, Seiad. Of this about 50 acres is placer gravel on a low terrace of the Klamath River, with a bedrock of dark, greenish-gray schist containing lenses of crushed quartz with widths of a few inches.

In 1933 and early 1934, Collins had mined about 750 cubic yards from a pit practically on the water's edge of Klamath River. The deposit is here 10 ft. deep including 5 ft. of sand overburden. The work was done with water pumped from the river by a 4-inch centrifugal pump and automobile engine. Some piping has been done with this water, but most of the gravel has been shoveled into the sluice box, which is one foot wide. Gold from this work is stated to have been sold for $400. No account was kept of prices received for different lots sold, but approximately half of it was sold at $16 per ounce and half at $26 per ounce. Gold is rough, and is usually in pieces worth 5¢ and 10¢. The largest pieces are worth $2 or $3.

An area of about two acres was worked on the south end of this property, 40 years ago, by Chinese. Depth here is 15 ft. This is a higher channel, 200 ft. east of the present river, and the bedrock is roughly 40 ft. higher than river level. A green dike (andesitic ?) in the schist forms the west rim of the pit. Water for this hydraulic mining was brought from Cade Creek.

Commodore Mine is in Secs. 26, 27, 34, 35, T. 46 N., R. 9 W., 30 miles by road from Yreka. It was described in State Mineralogist's Report XXVII, chapter for January, 1931, at which time eleven unpatented claims and a mill-site were optioned by H. J. Barton of Yreka to *Swedish American Mining Co.*

The mine is now being operated by *Goodenough Mining Co.,* Chas. DeForest, president, 1209 Smith Tower Building, Seattle, Washington. Harvey L. White of Walker (post office) is in charge, and he and three other men are at work, opening an old part of the mine known as the Davis workings. Old drift-adits of a length of 300 ft. have been cleaned out, and 100 ft. of new work has been done. A quartz vein carrying oxides of iron and free gold is exposed in widths varying from 12 inches to 22 inches. The dip is nearly vertical; and both walls are granodiorite. A basic dike, 75 ft. in width, carrying low-grade values in gold, occurs on the property. Present operators have cleaned out an old 250-adit that was driven to explore the dike.

In 1934, considerable work was done at this mine under the supervision of William L. Merritt, mining engineer, Railway Exchange Building, Portland, Oregon. Workings on the Commodore vein of a total length of 1000 ft. of crosscuts and drift-adits were cleaned out, and some new work was done. While these workings are open at the present time, they are not in use. In each of the two adits at the Insurance (see reference above), 100 ft. of new work was done. The basic dike was explored by means of 250 ft. of new tunnel driven entirely through a ridge.

Cornish Mine is on Big Humbug Creek northwest of Yreka. In 1930, a strike of good ore in a vein 28 inches wide was reported by F. M. McConochie and Henry Hayes. The mine has not been visited.

Cosmos Mines Development Co. is operating the Hansen mine, which see.

Davis Consolidated Mines (Placer) extend along Klamath River at Happy Camp for a distance of nearly three miles. They have been worked extensively by the hydraulic method during different periods from 1852 to 1919. The owner is Estate of Reeves Davis; address, W. F. Davis, executor, 427 J street, Sacramento.

According to W. F. Davis, the property now comprises 500 acres, patented, and 103 acres, unpatented, in Secs. 2, 10, 11, 15, 16, T. 16 N., R. 7 E., H. M. No land is now held in Secs. 21, 22, the ranch having been sold. He states that 400 acres of unmined ground remain, on the right bank of Klamath River only. Both sides of Indian Creek and both sides of Grider Creek are included. The ditch from Grider Creek was put in serviceable condition in the fall of 1932, and hydraulicking has been carried on during the seasons since. About one-quarter of an acre was mined off in the season, 1933–34, from a pit on Grider Creek, with a 20-ft. face. During the season, 1932–33, the location of the work was half a mile farther north on Curly Jack Creek, in a pit with a 30-ft. face. Three men were working.

The property is equipped with a sawmill, which will require reconditioning, and some other buildings.

In addition to this main property at Happy Camp, the Estate of Reeves Davis owns a 160-acre unpatented claim in Secs. 6, 7, T. 16 N., R. 8 E., a few miles up the river. This is primarily to cover a tunnel-site across the "boot bend" to drain the river channel for mining. However a prospect tunnel has exposed a high terrace containing gravel, 150 or 200 ft. above the present river. At a point some 40 ft. below, 300 or 400 cubic yards have been worked out with a giant as prospecting and assessment work.

Davis and Howard also hold 60 acres on the South Fork of Indian Creek, 14 miles above Happy Camp. This includes the *Jade* claim of 40 acres and an unnamed claim of 20 acres. On the latter is a 4-ft. vein of green *Californite.* Boulders of a good quality of this mineral are found in the creek. Two men are placer-mining for gold on the Jade claim. References to earlier reports on the Davis properties are given in the accompanying table of mines.

Dewey Mine is an old producer in Sec. 6, T. 41 N., R. 6 W., at an elevation of 6800 feet. The last of this old work was done in 1917. References to reports on it are to be found in the accompanying table of mines. Production during the earlier years of operation (about 1907) was from oxidized ores mined above the 100- and 200-adit levels. From Gazelle, the mine is reached by 10 miles of mountain road.

Dewey Gold Mines Trust, Gazelle, California, or 412 Chanin Building, New York City, has reopened the Dewey mine recently. The 300-adit level, at the same elevation as the top of the mill, has been cleaned out and retimbered where necessary, and roughly 2000 ft. of drifting and cross-cutting are now accessible. At a point 700 ft. from the portal is a winze on the vein, which goes down 150 ft. to the 450-level. Preparations are being made to unwater this.

The vein, consisting of quartz in widths as great as 12 ft. with walls of a basic diorite or a gabbro, strikes east and west, and apparently has a dip of 70° or 80° north but great variations in dip occur. Operators state that sulphide ore of good grade is known to exist in the bottom of the winze. Several hundred feet of diamond drilling have just been done to prospect in the walls of the main vein for parallel veins; and the results of this are stated to have been good.

The 10-stamp mill of 950-lb. stamps, with plates for amalgamation, two Gilpin County end-bump tables, and three Wilfley tables, has been repaired. The seven-mile power line has been rebuilt to provide electric power throughout. Capacity is 30 tons in 24 hours through a 24-mesh screen. This is to be used as a pilot-plant, and flotation will probably be added if laboratory tests are satisfactory. The mill building contains a single-stage duplex air compressor driven by a 50-hp. motor.

O. L. Scribner is mill superintendent. F. A. Wright, 806 California Building, Oakland, California, is manager.

Eliza Mine in Secs. 4, 5, 8, 9, T. 45 N., R. 8 W., is owned by R. H. DeWitt of Yreka. The mine is reached by means of a fair road, 15 miles long, which turns from the state highway at Hawkinsville, two miles north of Yreka. The last few miles are steep and narrow. A vein showing a width of from a foot to 10 ft. of quartz, averaging about 4 ft., is developed on the fifth level with 800 ft. of drifting. The strike is nearly north and south, and the dip is 70° west. At an elevation 224 ft. lower, more than 1000 ft. of work has been done in the country rock without picking up the vein. A raise connects the two levels; and short crosscuts from this should locate the vein, and point the way for additional development work. It is a typical fissure vein with ribbon quartz containing arsenopyrite, sphalerite and galena in small amounts.

O. H. Lawson, who was doing assessment work at time of visit, estimates the average value per ton at $7.60 in gold. The exposures are large enough to warrant systematic sampling and the preparation of an assay map, which is not available at present. Lawson states that the ore is all in place from the fifth level to the fourth, on which 500 ft. of drifting has been done, a vertical distance of 137 feet. All ore above the fourth has been stoped, except a length on the strike of 180 ft. where the ore was base. This ore was treated by amalgamation in an old 10-stamp mill, operated by water power, that stands on the property. Past production has been reported as about $150,000.

State Mineralogist's Report XXVII, chapter for January, 1931, contains a map of these workings on the two lower levels. References to earlier reports are contained in the accompanying table of mines.

Elliott Creek Mines Company (Placer) holds a property of 450 acres, formerly known as the *Daffodil*, on Elliott Creek just south of where it crosses the state line in Sec. 18, T. 48 N., R. 10 W., M. D. M., 40 miles from Medford, Oregon. The last six miles up Elliott Creek is trail. The property was idle when field work was done in this district, and it was not visited. Information given here was supplied by Harry Whitney, Copper, Oregon. W. L. Cobb, Roseburg, Oregon, is president of the company, and Dr. Sealy is secretary.

Gravels in the channel of Elliott Creek are covered by a big slide of schist. At the toe of this slide, on the opposite side of the channel, a point of solid schist juts out; and through this a tunnel, 565 ft. long, has been driven to reach the gravels. Washing is done in a sluice installed in the tunnel, with water brought through 2000 ft. of 3-ft. by 5-ft. flume.

Empire Group of 60 acres in Sec. 27, 34, T. 41 N., R. 9 W., M.D.M., 41 miles from Gazelle, is held by J. W. Wright of Etna. Claims are called Empire, May Day and Reed. There is a quartz fissure vein on each claim in a series of slates and cherts intruded by andesitic dikes. The May Day vein varies from 4 inches to 18 inches in width, averaging 8 inches. It strikes northerly and southerly, and has a vertical dip. A drift tunnel, 300 ft. long, gives backs of 50 feet. Ore has been removed from small stopes, 15 ft. long, and has been treated in an 8-ton Ellis mill on Sec. 27, owned by Dan Roff of Etna. It is equipped also with a crusher, and plates for amalgamation. The value of the ore is stated to be from $6 to $42 (gold at $20), free-milling, with some stringers giving $65. Sixty tons of ore that had been milled averaged $10 per ton. On the Empire claim, a similar vein has been developed with about the same amount of workings. Only a small amount of work has been done on the Reed, where arsenical ore is found.

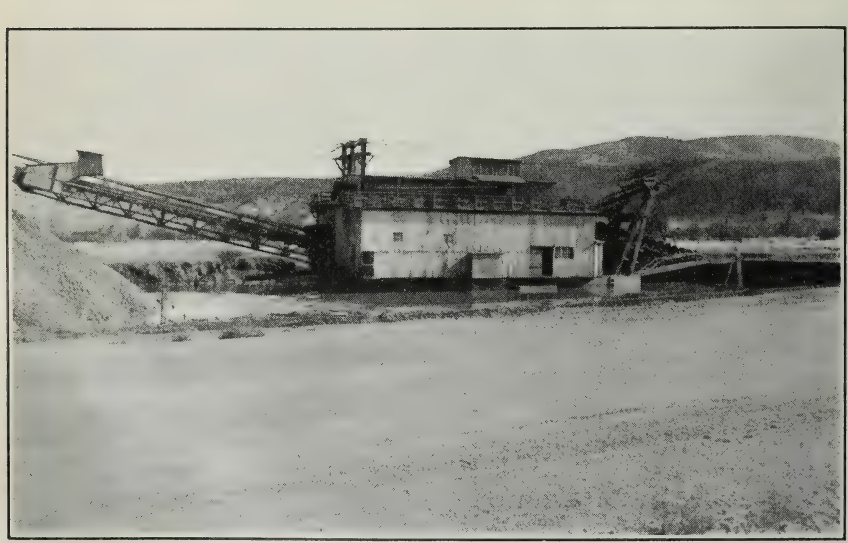
In Sec. 27, a quarter of a mile to the north, Wright holds the Lena claim. A 75-ft. dike, probably andesitic, contains quartz stringers showing plentiful chalcopyrite. Copper carbonate weathered from this has worked down through the fractures, and has stained the dike for quite a width. A tunnel started on the slope of a hill near the middle of the dike shows this stained dike material for 50 ft., then passes into the slates and cherts. Wright states that this 50-ft. width of dike assays $3.20 in gold (gold at $20). Five stringers in the dike, width 3 or 4 inches with a maximum of 18 inches, are said to average $25 per ton in gold. In a surface cut, a sample including a 4-inch stringer and silicified dike material to make a total width of 5 ft. is stated to have assayed $7 per ton in gold. A separate sample, 8 or 10 inches wide, including the stringer, gave $15.60 in gold, according to Wright.

Enterprise Placer of 100 acres, in Sec. 21, T. 45 N., R. 10 W., on the edge of the town of Scott Bar, is held by Hollis Anderson of Scott Bar and others. The property covers portions of four separate terraces of Scott River. Recent work includes a 50-ft. prospect shaft, of which the collar is 300 ft. higher in elevation than the present river; also a 26-ft. shaft at an elevation 60 ft. still higher. The material excavated carries numerous fragments of Abrams mica-schist; and these are said to be associated with the occurrence of placer gold. The bedrock is also of this schist, and contains small veins of quartz similar to the larger ones at the Quartz Hill mine nearby. These small veins also carry gold.

In 1855, an 1100-ft. adit was driven from river-level, and it was reopened in 1888. Some ground carrying high values in placer gold is stated to have been found; but caves and bad air drove the miners out. See State Mineralogist's Report VIII, p. 623.

Fledderman Bros. of Yreka are re-working tailing from old drift mining at the mouth of Greenhorn Creek, behind the Greenhorn school just south of Yreka, in Sec. 34, T. 45 N., R. 7 W. The drifting was done 35 years ago at a depth of 130 ft. below the surface. The gravel contained considerable clay, and it was not thoroughly washed in the original operation. The clay has now disintegrated to such an extent that the gravel washes well. Operators state that a recovery of 14¢ per cubic yard is being made, and that this is profitable. Digging is done with a gasoline power shovel of the dipper-stick type, mounted on caterpillar treads. The dipper has a capacity of a third of a cubic yard. All of the washing-machinery is mounted on a truck, and is driven by the truck engine. There is a hopper to receive gravel from the shovel, then a feeder driven by an eccentric to deliver a steady stream of gravel to the revolving trommel. This is punched with ½- and ⅝-inch round holes. Fines are washed in a sluice, and oversize is stacked by a conveyor belt. With three men working, 40 cubic yards are handled per hour; but only two men were workng at time of visit. A total of 16 gallons of gasoline is burned per 8-hour shift by the two machines. Water is brought in by gravity by means of ditch, flume and pipe from Greenhorn Creek. Prior agricultural rights to this water make the working-season short.

Fledderman Bros. washing tailing from old drift mining near Yreka.



Gardella Dredge (Cal Oro Dredging Co.) near Yreka.

Gardella Dredge. (Cal Oro Dredging Co.) A dredge with 5-cu. ft. buckets has been operated by Lawrence Gardella just south of the town of Yreka, and on the east side of the Pacific Highway during 1933, 1934 and 1935.

Gilta Quartz Mine is an old producer in Sec. 12, T. 9 N., R. 7 E., eight miles by trail south of Forks of Salmon. It is owned by G. A. Dannenbrink and others of Etna. In 1931, James Tracy of Forks of Salmon and Paul A. Bundy, Mining Engineer, were conducting a three-month prospecting campaign here with a crew of four miners. References to earlier reports on operations here will be found in the accompanying table of mines.

Gold Ball Mining Company is operating on the Stevens Group in T. 39 N., R. 11 W., at the head of Eddys Gulch near Sawyers Bar. F. A. Gowing, c/o Jas. M. Allen, Yreka, is president and general manager of the company, and A. F. Chapman is secretary. The mine is reached by 67 miles of road from Montague or 61 miles from Yreka. There is paved road for 31 miles, Yreka to Etna, and the balance is mountain road with grades of 15% and 20%. A 6000-ft. summit is crossed west of Etna, and when this is blocked by winter snows, a longer route by way of Somes Bar is used. Names of claims are Specimen, Blue Bell, Banner and Buster. Apparently part of it is a relocation of an old claim called the *Wisconsin*, which has been mentioned in earlier reports in connection with the *Mountain Laurel.*

Ore is being mined from a flat vein showing widths of 4 ft. to 5 ft. of quartz. It is developed by an intermediate level at the top of a 60-ft. raise from the Stevens adit. Treatment is in a new 25-ton mill containing 10-inch by 12-inch crusher, 4-ft. by 4-ft. Marcy ballmill, Dorr classifier, plates for amalgamation, and two Kraut flotation cells. Power is furnished by 100-hp. diesel engine, which drives a 260-cu. ft. compressor in addition to the mill. Considerable graphite from the graphitic schist country rock goes into the flotation concentrate. Mining has been done in this immediate vicinity at dfferent times under the same name as that given above or similar names, and references to earlier reports will be found in the accompanying table of mines.

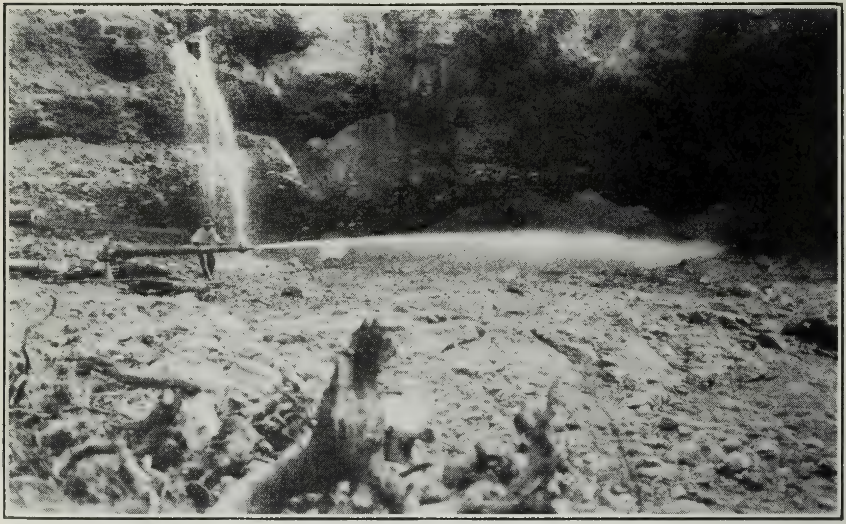
Golden Eagle Mine in Sec. 11, T. 44 N., R. 9 W., 10 miles north of Fort Jones, is owned by George A. Milne of Fort Jones, who owns several other patented mining claims and other patented ground adjoining. The mine has been worked at various times for many years, and total production is estimated at $1,000,000 by the owner. In 1927, the *Sterling Gold Mining Co.,* backed by Oakland people, did some work here; but little production resulted. The mine is developed with a steeply inclined shaft, the lowest level of which is 225 ft. below the surface. On this level more than 2000 ft. of work has been done, mostly drifting on veins with an average width of 2 ft. Milne states that the best ore came from a stope 200 ft. south of the shaft, now caved. The shoot is said to rake to the south; and Milne thinks that the best way to open up new ore is to sink the shaft and open up this shoot below. A map showing this lower level and its geology is contained in State Mineralogist's Report XXVII, chapter for January, 1931. Reference to earlier reports are contained in the accompanying table of mines. The only recent work here has been the milling of ore from the nearby New York mine.

The old mill from the New York mine has been moved to the Golden Eagle and set up with another mill. The combined plant now consists of the following: rock crusher, six 1000-lb. stamps, ten 850-lb. stamps, amalgamating plates, and an Overstrom table. This machinery is driven by electric motors of 40, 50 and 5 horsepower. At the mine are a 50-hp. electric hoist, Giant compressor, 2 cylinders, single stage, driven by a 50-hp. motor, three jackhammers, ore cars and tools. A 2-inch, 4-stage centrifugal pump is used to keep the shaft unwatered; and three air-driven pumps are on hand. A small assay office, fully equipped, also stands on the property.

Gold Leaf Mine of 80 acres in Sec. 26, T. 46 N., R. 7 W., six miles north of Yreka, is owned by J. M. Weaver of Yreka. It is developed by a 185-ft. tunnel and a 50-ft. winze. According to the owner, some gold ore of very high grade has been produced recently from quartz 2 inches to 12 inches wide in a 20-inch vein. When field work was done, the mine was idle and the winze was full of water, so it was not visited.

Good Hope Claim adjoins the Gilta to the south, and is held by Sam R. Israel, Forks of Salmon. It has not been visited.

Gravel Mines, Ltd., is operating a placer property known as the *Frank* (Shorty) *Lewis* mine in Secs. 5, 8, 9, T. 16 N., R. 8 E., H. M., about six miles east of Happy Camp. Five unpatented claims of 20 acres each are held. C. C. Broadwater, 27 Highland Ave., Piedmont, is president, and H. S. Shuey is secretary of the company. J. C. Moulton, Seiad, is in charge at the mine.



Gravel Mines, Ltd. Hydraulicking on high terrace of Klamath River near Happy Camp.

Gravel to be mined is on a terrace of Klamath River, 110 ft. higher than the present stream. Water is brought in from China Creek through 4200 ft. of 36-inch by 32-inch flume and 5400 ft. of ditch. Capacity is 1000 miner's inches, which is supplied to one No. 3 giant under a head of 175 ft. At time of visit, a 30-ft. depth of gravel was exposed in the pit recently opened. Bedrock is a slaty schist. Gravel is washed in 100 ft. of sluice, 26 inches by 26 inches, with block riffles, and plans call for the installation of some riffles of angle-iron; also undercurrents.

Gumboot Mine in Sec. 16, T. 45 N., R. 9 W., consists of five unpatented claims held by Jack McInnes and Philip McCool, both of Scott Bar. It is seven miles by road east of Scott Bar; but the last 1½ miles are too steep for an automobile and are used as sled-road only. Upper workings consist of a crosscut adit, 120 ft. long, passing through a series of impure limestones and slates, striking S. 22° E., and dipping 60° southwest. At the 120-ft. point is a drift on the vein 100 ft. in length. A raise from this drift connects with the surface, length 100 ft. measured on the dip of the vein, which strikes N. 55° W., and dips from 32° to 62° to the southwest. It varies in width from nothing to 5½ ft., with an average of 3 ft. A shipment of 18 tons from half way up this raise, said to have been unsorted, is stated by the owners to have brought gross returns of $75.73 per ton, 6 oz. being in silver, the balance gold (@ $20.67 per oz.). The ore is white quartz showing oxides and galena. The hangingwall is rhyolitic; and the footwall is calcareous slate. A sketch-map showing these workings is contained in State Mineralogist's Report XXVII, chapter for January, 1931.

Other veins show in shallow prospect cuts on the surface. One of these strikes S. 40° E. and dips 45° southwest. At an elevation 70 ft. below, 300 ft. of crosscut-adit has been driven through calcareous slate in an attempt to cut this vein on its dip. At an elevation 200 ft. below the workings first mentioned above, is a 200 ft. tunnel, which was started about 35 years ago to tap the veins. It passes through a metamorphosed sedimentary series, quartzite, limestone and slate.

Guy Ford Group of Mines—See Jumbo.

Hansen Mine in Sec. 1, 12, T. 9 N., R. 7 E., H. M., seven and a half miles by trail south of Forks of Salmon was being operated, late in 1934, by *Cosmos Mines Development Co.* The crew consisted of 10 men under Ralph Bender. A mill, said to be of 30 tons daily capacity, had recently been installed. The property was not visited. References to earlier reports are given in the accompanying table of mines.

Hathaway Mine. The following is quoted from State Mineralogist's Report XXVII, chapter for January, 1931:

> "It comprises the NE¼ Sec. 11, T. 40 N., R. 9 W., which is assessed to Albert S. Hathaway, *Sugar Creek Mining Co.*, 410 Holm Boulevard, Los Angeles. The *Sugar Creek Mining and Milling Co.*, C. Ray LaMar, president, 365 S. Cloverdale, Los Angeles, has done a little recent work on the property. At the time of visit, M. P. Mullen, Gazelle, California, was the only one there. A 340-ft. tunnel passes through impure limestone; and a drift has been driven on a vertical seam for a distance of 50 feet. The seam strikes N. 20° E., and has a width of one foot. The filling is a highly oxidized gouge, showing green copper staining and specks of sulphide. Mullen stated that this assays $10 to $12 per ton, and that, years ago, it produced $60,000 from a stope 95 ft. high, 85 ft. long and 30 inches wide. A raise from this lower level taps the stope; and 94 ft. above a second tunnel connects with the stope. The seam is in a basic dike, of which only one wall is exposed. The part of the dike that can be seen in the workings measures 32 ft. in width; and it has the same strike and dip as the seam mentioned above. The series of limestones, slates and cherts strikes S. 74° E., and dips 61° S.
>
> The Stevens tunnel is 400 ft. long; and it exposes a dike of similar basic rock, showing calcite seams, iron-oxide stain, and green copper stain. Mullen stated that an 82-ft. width of this assayed $4 per ton in gold. On railroad land in the SW¼ of Sec. 11, on which the company was said to have an option, is a vein with a maximum width of 5 ft., on which a tunnel 420 ft. long has been driven. The strike is N. 26° E., and the dip 57° to 80° northwest. The vein is similar in appearance to that first described; but the dark colored dike is lacking. A high content of lime also tends to lighten the color. The vein matter is highly stained with brown oxides of iron, and in places shows a high sulphide content. An 85-ft. raise was said by Mullen to have given an average assay return of $31 per ton for a 30-inch width. The footwall is a gray chert; and the hanging wall is an impure limestone.
>
> A 45-ton ball mill and concentrating tables were on the property, also a two-drill compressor, 10 by 12 inches, with two receivers. None of this machinery had been installed."

Since the above was written, some work has been done here by *Northern California Gold, Inc.* (see under Morrison & Carlock). However, when field work was being done in 1935, the property was idle; and it was not visited.

Hazel Mine, formerly *Jillson,* in Sec. 31, T. 47 N., R. 6 W., and Sec. 25, T. 47 N., R. 7 W., four miles southwest of Hornbrook, is the property of the Hazel Gold Mining Co., C. F. Kimball, secretary, 1103 First National Bank Building, San Francisco. Quartz veins, 3 ft. wide, carrying gold are found near the contact of the metamorphic series, called in this report Paleozoic and pre-Paleozoic sediments and schists, and the greenstone. Greenstone is the more prominent formation on the surface; but the dumps indicate that much of the work may have been in other formations. The mine has been idle for some time; and the workings were not examined. Reports of the State Mineralogist (see table of gold mines) state that the walls are slate. With the exception of one or two old buildings, and a 14-in. by 9-in. by 10-in. compressor, two-stage, connected by belt-drive to an 85-hp. motor equipped with starter, little remains on the property. The mill has burned. An interesting exposure of the basal conglomerate of the Chico formation is seen a quarter of a mile east of the mine. It is composed largely of pebbles and cobbles of various igneous rocks, andesites, diorites, greenstone, etc., also some chert. To the west of the mine workings is an outcrop of white and gray chert.

Herndon Placer Mine, in Sec. 17, T. 46 N., R. 7 W., is owned by A. C. Herndon of Hornbrook. A description of a former operation here is contained in State Mineralogist's Report XXVII,* to which the reader is referred. In 1935, a test of this property was being made by C. S. Lowe with a slackline excavator, using a steam donkey engine for hoisting. The mast supporting the cables of the excavator stands just behind a hopper, into which gravel is dumped. It is washed on a grizzly of 35-lb. rails with 2-inch spacing, and undersize passes to a sluice with riffles. Water is pumped from Klamath River at the rate of 700 gallons per minute with centrifugal pumps driven by two model-A Ford gasoline engines. With six men working, 150 cubic yards of gravel are washed per day.

Herndon Placer. C. S. Lowe operating slack-line excavator and washing-plant.

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* Averill, C. V., *op. cit.*, p. 58.

A year or two ago, an attempt was made by *Cosul Company* (Chinese) to work this property by the old method of developing power with current-wheels in the river. One wheel was used for hoisting gravel from the pit in a wooden skip. A second wheel drove a Chinese pump to remove water from the pit. Apparently the capacity of this outfit for moving gravel was extremely limited.

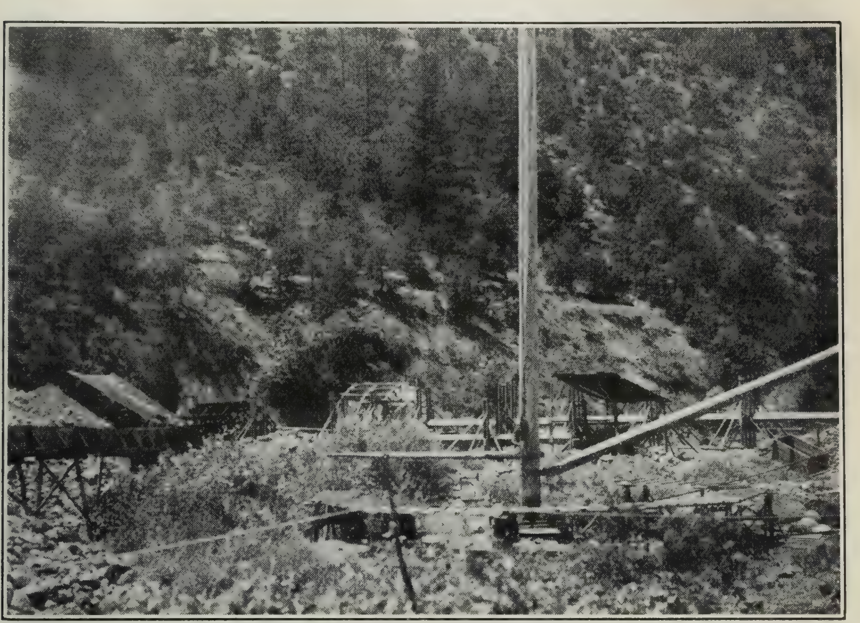


Photo by Walter W. Bradley.

Current wheels of Cosul Company (Chinese) in Klamath River, on Herndon Placer, 1933.

Hickey Mine, eight miles southeast of Sawyers Bar, is a property of six mining claims held by Edward Hickey of Sawyers Bar and San Francisco. It has been worked in a small way for many years, and a reference to a report on earlier work is to be found in the accompanying table of mines. For the past seven years, it has been leased by Jack Blaylock. He hunts out lenses of high-grade quartz in the decomposed formation, and treats the ore in a 4-ft. arrastre operated by hand power. The last 75 tons are said to have yielded a return of $35 per ton.

The deposit is apparently a network of stringers of quartz, an inch or so wide, in the country rock, probably a schist. The country rock has decomposed to clay, so that the deposit now is a loose, disintegrated mass of fragments of quartz mixed with clay. The depth to which this condition extends is unknown, but a tunnel has indicated a depth of 100 feet and more, in one place at least.

Lee DuBois of Yreka, who holds an option on the property, believes that this deposit contains enough gold to be profitably worked by power shovel for a length of 3800 ft. and a width of from 40 to 85 ft. He has made a preliminary sampling with this end in view. He states that 70 samples taken to a maximum depth of 6 ft. with a post-hole auger gave an average return of $3.34 per ton with gold figured at $20.67 per ounce. As much as four feet of soil overburden was found in places. A 2500-word report on this property, by DuBois, is on file at the Redding office of this division. There is a similar occurrence of gold on the Keaton property adjoining. A new road has been built to the Jumbo and Lanky Bob mines, within two miles from the Hickey and Keaton.

Hi-You Mine of three claims, the Hi-You, Aurora and Apex in Sec. 30, T. 45 N., R. 8 W., is held by G. A. Reichman and W. H. Young of Fort Jones. There is a good dirt road to Hi-You gulch, but the last mile to the mine is steep sled road. The only tunnel now open exposes a flat vein of ribbon quartz with a dip of 25°. In length this adit totals about 200 feet. The white quartz occurs in bands from half an inch to an inch wide, separated by very thin seams of graphitic material. Width of the vein is 1 ft. to 2 ft., averaging where seen by the writer about a foot. It outcrops with a width greater than 2 ft. at a point on the ridge about half a mile from the main workings. The quartz carries free gold and pyrite. Walls are graphitic schist, and considerable pyrite is seen on some of the fractures in this country rock. On the hanging wall, a very fine-grained dike, probably andesitic, is found for a short distance. Five other adits, now caved, have been driven. They vary in length from 70 ft. to 200 ft.

Ore from these workings has been milled at the 10-stamp mill on the Hi-You placer claim, a mile below, by the sled road. The stamps weigh 1000 lb. each. Treatment is amalgamation followed by concentration on a Wilfley table. A rock crusher and a 12-hp. gasoline engine complete the equipment. Returns from the ore have varied from $2 to $20 per ton.

Hi-You Placer on the gulch of the same name, and just below the quartz mine, is also held by G. A. Reichman and W. H. Young of Fort Jones. In May, 1935, it was being equipped with a large portable washing plant, including a trommel, to wash gravel dug by a power shovel. This installation was being made by a lessee.

Huey Mine is in Sec. 25, T. 18 N., R. 6 E., H. M., on Indian Creek above the Classic Hill mine, and about a mile distant. The deposits at the two mines are similar. David Huey and one other man work with a No. 2 giant supplied with water from Mill Creek through a three-mile ditch. References to this mine are given in the accompanying table of mines.

Hunter's Paradise—see Paradise.

Independence Mine in Sec. 32, T. 15 N., R. 7 E., H. M., 14 miles by road south of Happy Camp, is owned by *Buzzard Hill Mine, Inc.* J. E. Merriam, Bedford Hills, New York, is president of the company, and P. M. Tolman, Happy Camp, is secretary. Seven quartz locations are held on Independence Creek at an elevation of 1225 ft. Hornbrook, the nearest railroad station, is 87 miles east.

The mine is a pocket-mine, which produces gold from high-grade pockets in a quartz vein striking N. 45° W., and dipping about 60° southwest. Widths average 2 ft. to 3 ft., with maximums of 6 ft. to 8 ft.

Total production to date has been roughly $300,000. Country rock is a basic schist intruded by andesitic dikes.

Workings and equipment of this mine were described in State Mineralogist's Report XXI, p. 446. Since that report was written, the shaft has been deepened to the 180-ft. point, and there are four levels from it with a total of about 750 ft. of drifting. Drifting on the lowest level amounts to 40 ft. in one direction and 30 ft. in the other. A road, 4000 ft. long, from Klamath River to the mine has been completed; also 6000 ft. of flume with capacity of 500 cu. ft. of water per minute, giving 220 ft. of head at the mine. Water-power is used to operate the 10-stamp mill with stamps of 1250 lb. each, and to drive a 250-cu. ft. Ingersoll-Rand Compressor. There is also an old 450-cu. ft. compressor in poor condition. Buildings include a good bunkhouse, boarding house, and manager's house. Mill-runs have indicated that it does not pay to mill the quartz between pockets. When checked in 1934, this mine had last been operated in 1930 and 1931.

Indian Girl Mine of 40 acres, in Sec. 14, T. 46 N., R. 7 W., is leased to Jack Clute, Nick Kuntzler, Wayne Whitney and Hoyt McClain of Klamath River. It is just north of the Klamath River highway, but several hundred feet higher in elevation. The four lessees are hunting for pockets on the property, which has the reputation of having yielded numerous good pockets in the past. On the slope of the mountain is quite an accumulation of dump material from cuts and tunnels made by pocket hunters. Part of the work of the lessees consists of screening the surface detritus, including these dumps, and of washing the fines in a long tom. Water is accumulated behind a dam in one of the old tunnels. They state that an average return of $3 per cubic yard in gold, is obtained from the surface material.

Iron Dike Mine of four claims on North Hungry Creek, in Sec. 22, T. 48 N., R. 8 W., is held by D. M. Watt and brother of Phoenix, Oregon. The mine is reached by mountain road from Hilt, or by the road leaving the Klamath River at Beaver Creek. A 175-ft. crosscut in diorite reaches a vertical quartz vein 2 ft. in width, on which there is 40 ft. of drifting and a small stope. The quartz carries gold in occasional high-grade pockets, and some of the basic dike rock associated with the vein is said to carry gold. Quartz is hauled in a truck to a 3½-ft. Huntington mill about a mile down the mountain. Rated capacity is 10 tons per day. Three men are at work.

Jim's Seattle Placer Mine is a patented claim of 20 acres in Sec. 5, T. 16 N. R. 8 E., about five miles east of Happy Camp, owned by J. A. King, Happy Camp. It adjoins the patented 40 acres of the China Point Placer. Some production has been made here from the second channel of the river, about 50 ft. above the present stream. Prospecting for the next higher, or third channel, is in progress. The work consists of a 20-ft. shaft, all in overburden.

Johnson and Lewis group is a group on which some work has been done by the *Superior Consolidated Mines Co.*, 920 Lloyd Building, Seattle, Washington, with the late S. W. Steffner of Fort Jones as superintendent. The Johnson includes two patented claims assessed to

John J. Johnson and others of Etna; and the Lewis comprises four unpatented claims adjoining. The location is Sec. 18, 19, T. 43 N., R. 9 W., near the Morrison and Carlock mine. A quartz vein, 2½ ft. wide, is exposed on the surface for 1000 ft., exposures not being continuous, but at intervals only. Free gold can be seen in some of this quartz. A drift-tunnel on the vein, 110 ft. long, gives a depth of 110 ft. below the surface at the face, and, if continued to 1000 ft. will give 250 ft. of backs. An 80-ft. crosscut tunnel at about the same level has not yet reached the vein. Relations between the various kinds of country rock are complex here, slate, limestone, andesite and rhyolitic breccia being noted. The company named above has also controlled the Morrison and Carlock and the New York mines (which see).

Jumbo Mine is a property of eight claims in the northeast part of T. 39 N., R. 11 W., six miles by road southeast of Sawyers Bar. The part of the road up Whites Gulch to this property and to the Lanky Bob, half a mile beyond, has just recently been built. The Jumbo is owned by Guy Ford of Weed, and is optioned to Lee DuBois of Yreka. It has been worked at different times in the past, and references to reports on these earlier operations are to be found in the accompanying table of mines.

An old ten-stamp mill of 1050-lb. stamps, which still stands on the property, was supplied with ore from workings on the west side of Whites Gulch. The portal of the main adit level has caved, but the vein can be seen at the surface. The quartz is of the pulverulent, or highly fractured variety known as 'sugar quartz'. Water power for the mill was furnished by a mile of ditch that delivered water at a head of 286 feet. DuBois has recently been repairing this.

On the east side of the gulch are a number of old tunnels varying in length from 70 ft. to 400 ft. They expose at least two veins, one a flat vein with an average dip of less than 30°, the other nearly vertical. On the latter is an 86-ft. adit, from which a 44-ft. winze has been sunk. DuBois says that samples taken in the vicinity of this winze, with widths of from 3 to 5 ft., average $20 per ton with gold figured at $20.67 per ounce. He drove 68 ft. of crosscut to reach this vein at a point 150 ft. lower in elevation, but estimates that it must be driven an additional 100 ft. Country rock in this vicinity is chloritic schist, apparently developed from an old series of andesitic lava flows. A 1500-word report by DuBois on this property is on file at the Redding office of this division.

Kanaka Hill Hydraulic Mine of 160 acres of unpatented mining claims in Sec. 27, 33, T. 16 N., R. 7 E., H.M., four miles below Happy Camp, is held by Steve S. Green, Happy Camp. It covers gravel of a high terrace of Klamath River, some 250 ft. higher than the present stream. Water supply is taken from Kanaka Gulch, which flows during storms and for a few days following storms. A No. 2 giant is supplied through 400 ft. of 11-inch pipe. This is sufficient for small-scale operations only. A better water supply can be obtained from Wilson Creek, one and a quarter miles to the south. At time of visit, pits roughly 500 ft. long, 30 ft. wide, and showing a 14-ft. face of gravel, had been opened.

Katie May Mine is in Sec. 13, 24, T. 45 N., R. 8 W., in the Greenhorn District, near Yreka. Andy Calkins of Horsecreek (post office) holds six claims, of which four have been held for many years. Bob Macaulay and Jack Perdue are leasing. They state that years ago some $70,000 was produced from a stope 40 ft. long on a 10-inch vein; and this is confirmed in a general way in the references gven in the accompanying table of mines. The lessees have recently made a new discovery on an entirely different part of the property. They have made cuts totaling roughly 50 ft. in length, and 4 ft. deep, extending both above and below a CCC road that has recently been built through the property. Pieces of quartz, an inch in diameter, contain visible free gold in considerable quantity. At time of visit, it was difficult to tell the width of the deposit, because the bottom of the trench was still in loose material. A width of 18 inches of this is said to give good pannings.

At a distance of 800 ft. from this strike, on the opposite side of the high ridge, is an 85-ft. tunnel on a 9-inch quartz vein. Macaulay states that 9 tons of sorted ore from this yielded $248 in free gold only. It contains auriferous chalcopyrite, which was not saved by the mill on another property, where it was treated. At another locaton on the property, Macaulay sank a 23-ft. shaft on a 3-ft. quartz stringer zone, which is stated to have yielded $3,100 in gold. Country rock is schist, of which a part has the appearance of slate.

Keaton Mine is a property of five claims in T. 39 N., R. 11 W., nine miles southeast of Sawyers Bar, owned by James Keaton of Sawyers Bar and optioned to Lee DuBois of Yreka. The occurrence of gold here is similar to that at the adjoining Hickey mine (which see), and the Keaton has also been worked on a small scale, with short tunnels and open cuts, for many years.

In 1927, an Ellis mill with a rated capacity of 10 tons in 24 hours, Blake crusher, and plates for amalgamation were installed; and runs from two open pits were made. According to DuBois, 100 tons from a pit just above the mill yielded $5.20 per ton, and 65 tons from an upper pit yielded $3.24 per ton (gold at $20). The last two miles to this property must be traveled over a steep sled-road, and this was used in the transportation of gasoline to drive the 7-hp. engine. Hence the operation was not profitable.

DuBois believes that a deposit large enough to mine with a power shovel can be developed here, with a length of 1600 ft., width 40 ft. to 120 ft. and depth 50 ft. or more. With this end in view, he took 108 samples with a post-hole auger to a maximum depth of 6 feet. These are stated to have given an average return of $3.60 per ton with gold figured at $20.67 per ounce. In one place a width of 120 ft. was sampled with a row of 10 holes. A 2000-word report on this property, by DuBois, is on file at the Redding office of this division.

King Jade Quartz Mine of six 20-acre claims in Sec. 7, T. 17 N., R. 7 E., H. M., is held by Harry D. Maltis of Happy Camp. The owner states that recent prospecting has disclosed a 6 to 8-ft. quartz vein that pans well in gold. Considerable *californite* ("jade") has been found also. The property was not visited.

King Solomon Mines Company is operating in Sec. 14, T. 38 N., R. 12 W., 8 miles south of the Black Bear post office. Roy N. Bishop, 411 Crocker Building, San Francisco, is president of the company, and Harry M. Thompson, address, Black Bear, is in charge of operations. W. C. Baldwin is mine foreman, and Wm. Samuels is mill foreman.

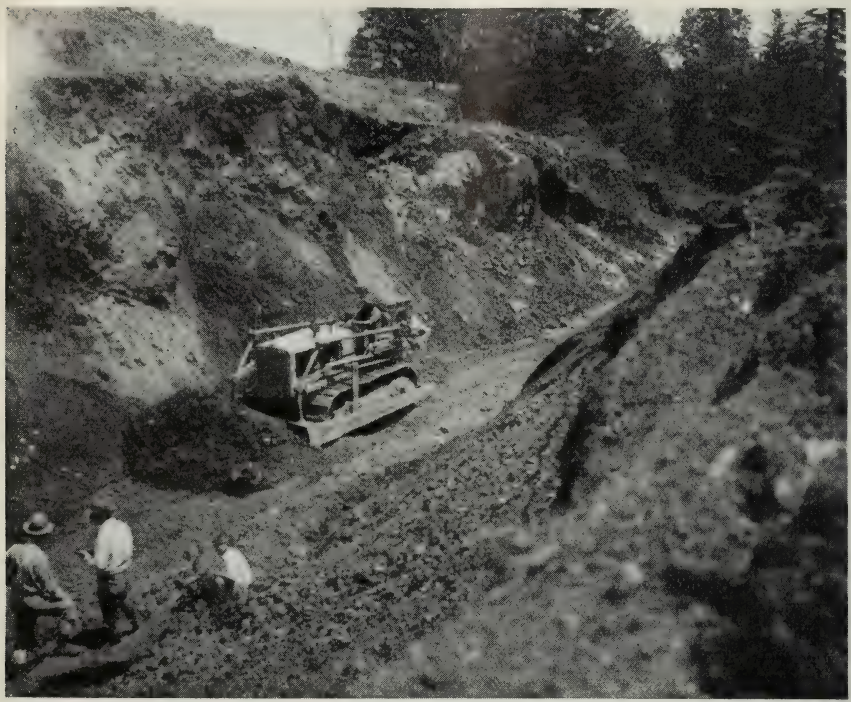


Photo by Walter W. Bradley.

King Solomon Mines Co., "mining" with caterpillar tractor and bulldozer scraper.

The mine is about 75 miles from Yreka, the first 31 miles, Yreka to Etna being hard-surfaced road, the balance mountain road with grades of 15% to 20%. The last eigth miles from Black Bear to the mine is practically all steep grades and sharp turns. This stretch was built by the present operators of the mine. When the 6000-ft. summit west of Etna is closed by snow, a route by way of Somes Bar is available.

Holdings of the present company are approximately 800 acres, including the old King Solomon holdings. Five of the claims are patented. The old work was done in the years 1900 to 1905, when four two-stamp batteries and a 5-ft. Huntington mill were in use. These 1000-lb. stamps, which were driven by steam power, are still on the property, but are in poor condition. Treatment was by amalgamation only. In this plant, 80,000 tons of surface ore were treated from a pit 560 by 100 ft. by 40 ft. deep. Recovery from this ore is said to have been $300,000.

Present operations were started in 1931, with an extensive campaign of prospecting and sampling by a method somewhat out of the ordinary.

An extension of the deposit formerly mined was developed by means of cutting trenches with road-building machinery, road-plow and 30-hp. Caterpillar tractor with scraper blade mounted in front (bulldozer). In this way 2000 ft. of trenches, 9 ft. wide, and of an average depth of 10 ft., were cut. Sampling by two independent methods was carried on at the same time. First, samples were taken by an expert panner, who made a rough estimate of the gold content by panning. The second method consisted of cutting 250 lb. of sample from each $2\frac{1}{2}$-ft. width of ledge matter exposed in a trench. This 250-lb. sample was taken to the assay office, and crushed to three-quarter-inch size, then reduced to 40-lb. with a Jones-type sample splitter. The 40-lb. sample was crushed to one-quarter-inch size and again split, then 10 lb. was ground to 40-mesh in a disc-pulverizer. A 4-lb. split was then charged to a 12-inch Geo. White muller for amalgamation with a drop of mercury. After grinding for five minutes, tailing was panned off and saved for a composite sample from each trench. The amalgam was parted with nitric acid, and the gold was weighed on an assay balance. A 4-lb. sample from the composite tailing sample from each trench was subjected to a second grinding of 10 minutes in the muller, and considerable additional extraction obtained. A fire assay was made of tailing from this second amalgamation test.

Photo by Walter W. Bradley.

Mill and aerial tramway terminal, King Solomon mine.

Mining of the deposit so developed is now in progress. The earlier mining was done partly with a 50-hp. Caterpillar tractor with scraper blade (bulldozer), particularly the stripping of the first 20 ft. of depth. This machine pushed the surface material over a bank, so that a power shovel could be used to load it on trucks. Present mining is done entirely with a $\frac{3}{4}$-yard shovel powered with a diesel engine. Trucks deliver the ore to the head of a 2500-ft. aerial cable tram, where the primary crushing is done. In this way, five men are able to mine 300 tons in 8 hours, including two men to run the cable tram. On the latter are 16 buckets of one-half cubic yard capacity each, delivering ore to the mill.

The new mill contains two Hardinge pebble mills in closed circuit with a 20-mesh vibrating screen. Due to the softness of the ore, 70% of the output of these mills will pass a 200-mesh screen. Pulp is treated on large amalgamation plates, then goes to Kraut flotation machines. On account of the varying character of this ore, due to differences in oxidation and weathering in different parts of the deposit, operators have experienced difficulty in keeping the flotation process adjusted. They are now considering a cyanide treatment for amalgamation tailing. Power is furnished by an engine rated at 250 hp., which delivers about 200 electrical horsepower; and motors are used to drive the various machines. The engine burns 250 gallons of 27° Bé. oil per day. Storage of 43,000 gal. of this diesel fuel is provided for winter.

The ore occurs in a schist, which was probably originally a sedimentary rock. It has been intruded by dikes, probably dioritic, in such a way that, as one crosses the lode, a change in formation is noted every few feet. Quartz, calcite, and actinolite? occur in seams and vugs. The ore is all highly oxidized and shows the red, brown and yellow colors of oxides of iron, also some black oxide of manganese. According to the operators, the gold is all in the schist and the dikes are barren. In addition to these formations, which were seen in the orebody being mined, several others were noted in the immediate vicinity. On the ridge behind the mine is a basic igneous rock, possibly gabbro, intruded by an occasional fine-grained, nearly white dike, probably rhyolitic. One dike contains feldspar phenocrysts about a quarter of an inch long, and is apparently andesitic. A little limestone float was noted. The basic rock (gabbro?) is stated to have produced some good pocket-gold.

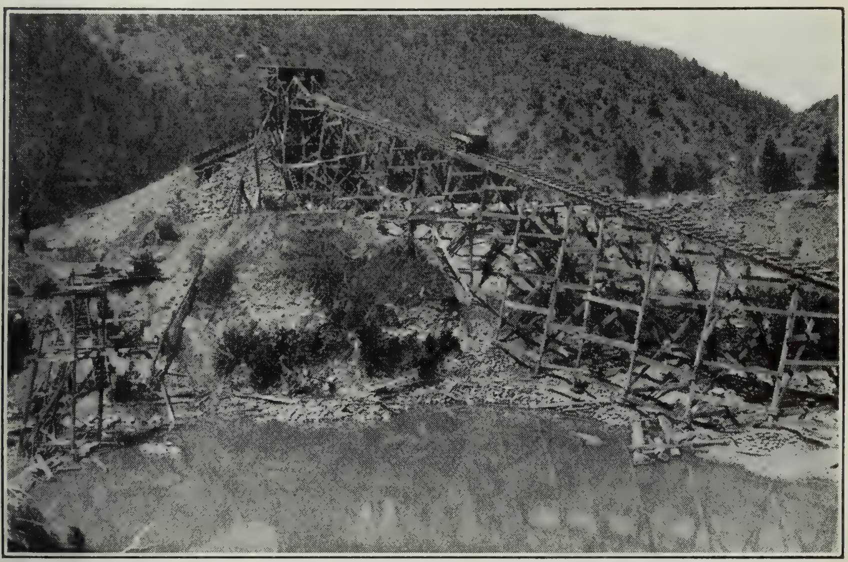
See the accompanying table of mines for references to notes on earlier work at this property.

King Tut Mine of three claims, in Sec. 32 T. 41 N., R. 7 W., is held by T. A. Lloyd of Gazelle. He holds an option on the adjoining SE. $\frac{1}{4}$ Sec. 29, also. An old shaft, said to be 55 ft. deep has been cleaned out by Lloyd to the 28-ft. point. It follows a nearly vertical fracture zone in a series of andesites and diorites, possibly gabbro. Occasional bunches of quartz show specks of chalcopyrite and considerable green copper stain. Lloyd states that he has obtained assays of $5.95 and $11.20 in gold from pieces of this quartz.

Klamath Placer Mining Co. is mining the *McConnell Bar* on Klamath River, six miles west of the Pacific highway. The property comprises three patented mining claims of a total area of 68 acres in Sec. 16, T. 46 N., R. 7 W. Officials include W. D. Miller, president, Klamath Falls, Oregon; L. J. Troy, secretary, Santa Monica, California; C. T. Phillips, vice president, in charge of washing operations; and Lee L. Parker, foreman.

Mining is being done in a pit 14 feet below river level with a one-yard gasoline shovel. A strip of gravel is left between the pit and the river, and seepage water is kept pumped out. The pit is an extension of one started in 1910, and it is now 1700 ft. long. Gravel is loaded by the power shovel into two three-yard dump trucks, hauled a maximum of 1000 yards, and dumped into a three-yard skip running on inclined 16-lb. rails. These are mounted on a trestle, 370 ft. long at a grade of 24% to reach the top of the washing plant outside of the pit. At the top is a gasoline hoist, which raises the skip and dumps the gravel onto a grizzley with eight-inch openings. Capacity is 500 cubic yards in eight hours, handled by nine men.

Gravel that passes through the grizzley is washed in a sluice containing 147 ft. of block riffles, set at a grade of eight inches in 12 feet. Seepage water from the pit is delivered to the top of the washing plant by a 5-inch centrifugal pump working against a head of 60 ft., and driven by a 25-hp. engine. This burns 2½ gal. of stove oil per hour, costing 10¢ per gallon. Additional water for washing is taken from the river by a 10-inch centrifugal pump working against a head of 50 feet. It is driven by a 52-hp. diesel engine, which burns 4 gal. of fuel per hour, costing 8¢ per gallon. Sands below $\frac{3}{16}$ inch in size are passed through the bottom of the main sluice by a grizzley with openings of that size, for treatment on an undercurrent. This is a table, 8 ft. by 12 ft., set on a slope of 15 inches in 12 ft., and equipped partly with Hungarian riffles and partly with angle-iron riffles. Some recovery is made in sluices below the undercurrent on ¼-inch screen over burlap. Costs for the entire operation are stated by the operators to be 22¢ per cubic yard including all depreciation and overhead.



Klamath Placer Mining Co. Tram from pit, and washing-plant.

They have made assays and a mill-test of sand-tailing from the undercurrent, and state that it contains $4 per ton in gold. A pebble mill is to be installed to grind the sand for a further recovery. Plans also call for later turning the river through the pit to drain the present river channel for mining.

Knownothing Placer is a tract, in Sec. 15, T. 16 N., R. 7 E., near Happy Camp, that was surveyed for a mining patent, but was not patented. Later parts of it were patented as agricultural land. They are held by Lee Effman, Mike Effman, Frank Lowrey, of Happy Camp, and various other persons. C. E. Reagan and C. T. Bonney of Happy Camp hold unpatented mining claims. They believe that there is good dredging land here, also gravel that can be worked by the hydraulic method with water from Elk Creek.

Lanky Bob and Slim Jim Claims on Whites Gulch, five miles east of Sawyers Bar, have been relocated as Gold Bug No. 1 and No. 2; and are owned by G. T. Salsbury of Etna. They are leased to Joseph T. Sugars, H. W. A. Docker, Harry Summers and Frank Cantrill of Sawyers Bar. These men, with the help of other miners in the vicinity and of the U. S. Forest Service, have just completed two miles of new road reaching the Lanky Bob mill.

The mill has been reconditioned and now consists of two 1000-lb. stamps, 5-inch by 7-inch crusher, Ellis Independence mill for regrinding, and a 4-ft. by 9-ft. plate for amalgamation below the stamps. Below this plate is a small classifier of the cone type, from which the slime goes to three home-made flotation cells containing mechanical agitators, and the sand goes to the Ellis mill, below which is an 18-inch by 2-ft. amalgamating plate. A Pelton wheel supplied with one cubic foot per second of water under a 210-ft. head drives the mill. Due to shortage of water at time of visit, an 80-hp. automobile engine had just been substituted.

Roughly 250 ft. higher than the mill is the lowest tunnel, 900 ft. long, of which 50 ft. is new work. It exposes a vein from half a foot to four feet wide, containing quartz, gouge, free gold, pyrite, and a little galena. The strike is S. 20° W. dip is 60° or 70° to the east. Walls are of an andesitic rock. According to Sugars, the quartz alone assays $40 per ton in gold. Workings on older levels above this one have caved. References to reports on this earlier work are contained in the accompanying table of mines.

Little Crumpton (Placer) is on a terrace of Klamath River in Sec. 1, T. 16 N., R. 7 E., H. M., near Happy Camp, and is owned by Clifford and Leonard Crumpton, Happy Camp. In 1934 it was leased to W. A. Minner, Bakersfield. Equipment was installed for hydraulicking with water pumped from the river to the terrace, 120 ft. above. An 8-inch centrifugal pump, rated at 2200 gallons per minute against a 340-ft. head was driven by a Liberty airplane engine by direct connection of the shafts of the two machines. The pump worked against a head of 240 ft. by gage, of which 120 ft. was lift, the balance nozzle pressure. The pump was connected to a No. 2 giant (4-inch nozzle opening) with 300 ft. of 11-inch hydraulic pipe. Gravel was sluiced through eight boxes, 12 ft. long and 20 inches wide; and material that would pass through a $\frac{1}{2}$-inch screen was treated on undercurrents, 24 ft. long and 12 inches wide. About 2000 cubic yards were moved, leaving a 20 ft. bank of gravel at the back of the pit. Fuel-consumption of the engine was 10 or 11 gallons of gasoline per hour. Property was idle at time of visit in May, 1934. Equipment included a ferry across Klamath River, consisting of cable and barge.

Lowden Placer (Ariel Lowden) is in Secs. 11, 12, 14, T. 46 N., R. 12 W,. near Seiad. When this property was visited in June, 1933, some new hydraulic pipe had just been installed. According to J. H. Ladd of Seiad, who was living at the property, this supplies the mine with 1200 miner's inches of water under 100 ft. of head, from a 2½-mile ditch out of Seiad Creek. He said also that a new bedrock-ditch was to be cut immediately so that it would not be necessary to stack tailings.

T. L. Park of Seiad called at the Redding office of this division in September, 1934, and stated that he had acquired this property and that of Ladd, and had located three claims to give him a total acreage of 452½. He planned to operate under the name of *Seiad Placer Mines,* a copartnership. References to reports on earlier operations at this mine will be found in the accompanying table of mines.

Hydraulic pit at Lowden mine of Seiad Placer Mines, Inc.

In May, 1935, E. E. Chester was finishing up a season's operations of this property, under a lease and option obtained from Seiad Placer Mines, Inc. He had three No. 3 giants, of which only two were operated at a time. The pit was on a part of the property known as the Williams channel, and exposed a bank of stratified sand and gravel 72 ft. in height. The pit is drained by a cut through the gravel and a rim of hard, dioritic bedrock, to Klamath River. The cut is 500 ft. long and has a maximum depth of 100 feet. Twelve men were at work, and kept the mine in operation for three shifts per day. At time of visit, the yardage moved during the season had not yet been measured, and the final cleanup of the sluices had not yet been made.

Lowden Placer (Jack Lowden) comprises 33 acres patented land and 40 acres unpatented mining claims in Sec. 13, T. 46 N., R. 12 W., just across Klamath River from Seiad. It has recently been purchased by S. R. Huey of Seiad and Newcastle, Pennsylvania. One giant was operated for two shifts per day, during the water-season of 1934–35, under S. K. Wood of Seiad. Equipment includes a ditch from Walker Creek to give 2000 miner's inches under a head of 200 ft. at the mine. This amount of water is available during the winter season. Wood states that a water right is owned to the first 1000 inches from Walker Creek, dating back to 1878. There are 1000 ft. of 10-inch and 15-inch pipe, a No. 2 giant, and a No. 3 giant, using nozzles with openings of 4½ inches and 6 inches respectively. Prospecting done since the water-season closed has shown that there is some very good gravel at a different location in the property from that recently mined. The good values are stated to occur in depths of gravel up to 25 feet.

Mat-a-pan Mine in Sec. 17, T. 45 N., R. 10 W., M. D. M., a half mile due west of Scott Bar, is a 20-acre claim owned by M. O. Payne of Scott Bar. In 1933, it was leased to F. E. Sette. The deposit is quite similar to that at the Quartz Hill mine at Scott Bar, which has been described in reports of this division as noted in the accompanying table of mines. It consists of a network of quartz veins in Abrams schist. Individual veins are usually not over 2 ft. wide, and for the most part only a few inches wide. The maximum width of quartz found in such a vein has been 8 ft. The white quartz carries pyrite, galena, and free gold. Ocher seams carry oxides of iron and manganese, and contain pockets that have been productive of free gold. Seven men were at work hydraulicking the decomposed surface material, also for some distance into the firmer rock below, and searching for pockets in the seams. A No. 2 giant is supplied with water through half a mile of ditch, at a head of 275 feet. In June, the water supply was such that it was necessary to let a reservoir fill for two hours to get a run of 1½ hours with the giant. Water season is eight months, lasting throughout the summer.

Minerals Recovery Corporation, Ltd., installed some machinery at the Portuguese Hydraulic Mine (see accompanying table of mines), about 1931, but has not operated there recently.

Morrison & Carlock Mine is in Sec. 13, T. 43 N., R. 10 W., four miles northwest of Greenview. Since Dec. 1, 1933, it has been operated by *Northern California Gold, Inc.,* A. C. Sloss, President, Carl Blum, Secretary, 228 Burke Building, Seattle, Washington. A reorganization under the name, *Northern California Goldfields,* is to be made. At the mine, Wm. C. Madge is in charge of the crew of 15 men.

The property is developed by a shaft, which has been driven on a fault for a distance of 225 ft. at an angle of 62° with the horizontal. One segment of the flat vein is left behind at the 50-ft. point in the shaft, then there is a 72-ft. displacement, and the shaft passes into the footwall of the second segment. At the bottom, a crosscut has been driven to this segment, which is developed to lower levels by a shaft following the dip of the vein at an average angle of 26°. This shaft is 540 ft. long on the dip of the vein, and the bottom level is called the eleventh. At time of visit in April, 1935, 50 ft. of new sinking and 300 ft. of new drifting had been done. The quartz vein is 12 inches to 14 inches in width. In stoping, the hanging-wall waste is broken for a width of about three feet to give room to work, then the quartz is broken separately. As much as possible of the waste is stored in the stopes. Country rock in the underground workings is greenstone. On the surface, an acidic dike is evident, and this is stated to have yielded considerable gold when the mine was first worked, years ago.

Ore is treated at the mine in the 10-stamp mill of 850-lb. stamps, the feed for which is broken by a 9-inch by 12-inch jaw crusher. Treatment is by amalgamation only, by which operators claim a 95% extraction. Capacity is 20 tons in 24 hours. Other equipment includes a two-cylinder air-hoist handling a one-ton skip in the main shaft; a 15-hp. electric hoist underground; 12-inch by 10-inch air compressor driven by a 60-hp. motor, and two centrifugal pumps, one driven by a 20-hp. motor, the other by a 35-hp. motor. For references, see accompanying table of mines.

Mount Vernon Mine is now assessed to Kathryn J. Pfeiffer, c/o K. K. Ash, Yreka. It comprises 70 acres of patented and 40 acres of unpatented land in Sec. 26, T. 45 N., R. 8 W. The following is quoted from State Mineralogist's Report XXVII, which also contains a sketch-map of the main level, made at that time:

"The mine is eight miles west of Yreka by a good road at an elevation of 4434 feet. It has been worked irregularly for more than 50 years. A syndicate with Kenneth K. Ash of Yreka as manager has recently done 915 ft. of new development work on the fifth or mill level, which is 1000 ft. below the outcrop on the dip of the vein. This level (Fig. 4) now consists of a 650-ft. crosscut to the vein, 900 ft. of drifting on a vein with strike S. 10° E., dip 41° E. at face, 130 ft. of drifting on a footwall branch vein, strike S. 16° W., dip the same as the other, and a 40-ft. crosscut between these. The crosscut exposes a stringer zone between the two veins. Ash estimates that a width of 8 ft. of this ran $8 per ton on the mill test. The veins are on fault fractures, and show a width of from 0 to 2 ft. of ribbon quartz, which contains a little pyrite, galena and sphalerite. The quartz is fractured and broken, indicating movement on the old plane of weakness since the veins have been formed. Ash thinks that the Mount Vernon vein, worked on the old levels, has not yet been found on this level. An old raise starts from the main drift on the fifth level and runs 550 ft. to a point above the third level, from which point there is a crosscut 140 ft. long to the Mount Vernon vein. Caving conditions make it impossible to survey these workings. From the fifth level the operators have recently sunk a 95-ft. winze, which was full of water to a point 20 ft. below the level at the time of visit. Ash states that a sample from the 30-ft. level in the winze, width 12 inches, assayed $97 per ton. According to Ash, in 1928–29, a mill run of 775 tons was made on material that was diluted 5 to 1 with country rock, which, however, may carry a little gold near the vein. Recovery was $4.65 per ton in free gold; and concentrates were saved, which are estimated at 6 tons running $97 per ton. No concentrates were obtained from the first 265 tons, which were milled before the concentrator was installed. A No. 6 Wilfley table has been added to the 5-stamp mill; and other new equipment includes a two-drill Sullivan single-stage compressor, with 40-hp. motor. On the winze are a 5-hp. geared hoist, 3-hp. motor and blower, and a self-dumping skip of 1500 lbs. capacity. The power line of the California-Oregon Power Co., running to Fort Jones, crosses the property.

South of the main workings of the Mount Vernon, a specimen was taken from an open cut on a 20 to 30-ft. dike. In the hand specimen it is a light-colored gray rock with a suggestion of a cream color, but darker. A few phenocrysts of quartz and somewhat more numerous needles of a highly altered mineral, probably hornblende, are seen in a very fine-grained ground mass. Maximum diameter of the quartz phenocrysts is 1/16 inch and maximum length of the dark needles is less than ⅛ inch. Under the microscope, large phenocrysts of feldspar are fairly abundant; but they are almost entirely altered to sericite. An occasional crystal of quartz or bleached biotite is seen. The rock is highly silicified, the groundmass consisting now of finely crystalline quartz of secondary origin and microscopic flakes of micaceous material. Much of the iron has been leached out of the rock. The needles, thought to be hornblende, are very indistinct under the microscope, because they have been entirely altered to secondary minerals. A few of the feldspar crystals show unaltered parts that can be recognized as albite. The original nature of the rock is uncertain; probably it was rhyolitic, perhaps dacitic. The type of alteration is interesting, as it indicates that mineralizing solutions have been acting on this dike. This dike is intrusive into the andesitic greenstone."

The mine has been operated continuously by Ash since the above report was written. His present crew is four men, and he mines and mills an average of four tons of ore per day. The winze has been deepened to the 130-ft. point, and two levels have been run from it. On the 77-ft. level, 200 ft. of drifting has been done, and on the 125-ft. level, 225 ft. There is also a 55-ft. crosscut into the hanging wall on the 125-level, and this entire width of country rock is stated to give assays in gold. Gross production from these workings from the winze, including stoping, is stated to have been $18,000. The ore-shoot is said to be longer as depth is attained in the winze, the length on the 125-level being 175 ft. The main level has been extended an additional 400 ft., and three stopes, 55 ft., 40 ft., and 20 ft. long, have been mined out to an average height of 50 ft. Drifting from the winze has not been extended far enough to reach these shoots. Stoping-width averages 18 inches.

To make a mill-test of the country rock, 10 tons were mined at a point where the vein had already been removed. The returns figured $7 per ton with gold at $35 per ounce, according to Ash. In addition to the minerals named in the report quoted above, some of the ore recently mined contains arsenopyrite. References to earlier reports on this mine are given in the accompanying table of mines.

Nebraska Mine comprises lots 2 and 3, NE. $\frac{1}{4}$ SE. $\frac{1}{4}$ Sec. 7, T. 46 N., R. 6 W., 122 acres of patented land. By trail, it is a mile west of the Pacific highway, on Rider Gulch, which enters the Klamath at Sawyer's Camp. A dike, probably andesitic, intrudes the graphitic schist series. It is 50 ft. or more wide. The fresh rock shows a sprinkling of minute crystals of pyrrhotite. Quartz veinlets, an inch or two wide, in the dike carry free gold. Where one of these comes in contact with the graphitic schist wall-rock, a good pocket is likely to be found. In May, 1935, two men, Harry Bieglow and Andrew Milne, were working on these veinlets of quartz. Some sampling has been done in an effort to determine if the entire dike contains enough gold for profitable mining. Apparently this sampling has not been very extensive, and is not conclusive. F. C. Dechaine holds 40 acres on the same dike, to the south of the Nebraska; and G. A. Reichman of Fort Jones holds 40 acres to the north. R. S. Stryker of Yreka holds a lease on the Nebraska.

New York Mine in Sec. 2, T. 44 N., R. 9 W., M. D. M., near Fort Jones, comprises 109 acres of patented mining claims, owned by Geo. A. Milne of Fort Jones. In 1933, G. C. Berker, Fort Jones, and C. C. Plumb, Providence, R. I., were working the mine under lease and bond.

A quartz-filled fissure vein carrying pyrite and free gold occurs in greenstone (probably Copley meta-andesite). It is developed by means of an incline-shaft, which is a crosscut, passing through the vein some distance above the 400-level. This level is 600 ft. below the surface, measured on the slope of the shaft, which has an average angle from the horizontal of 40°. The vein strikes north and south, and has a steep, variable dip to the east, averaging about 85°. On the 400-level, a drift on the vein was being driven to the north at a point 650 ft. north of the shaft. Of this distance, 400 ft. was new work. At a point 300 ft. south of the face, a fault was encountered, which displaced the north segment of the vein 40 ft. to the east. The stope that was being mined at time of visit was on this north segment, and was 114 ft. long, 20 ft. high and 3 ft. wide. Vein material was a banded, white quartz carrying free gold, pyrite and chalcopyrite. Some new work had been done to the south on the 400; but the vein was faulted and no ore-shoot was found.

On the 300-level, a drift was being driven to the north, and it was expected to cut the fault mentioned above very soon. At the south end of the 300-level, a raise was being driven for a second exit. This will connect with the 100, an adit level, which has caved, with the exception of the portion from the raise to the portal. There is also an incline from this level to the surface. It was planned to reopen the 200-level, which had caved, if the ore-shoot mentioned was found to extend above the 300-level.

Equipment included a 50-hp. electric hoist; Sullivan angle compound compressor, 12 inches by 7½ inches by 8 inches, driven by 75-hp. motor; 6-inch Byron Jackson turbine pump; No. 5 Cameron sinking pump; Sullivan drill-sharpener with oil-burning furnace for heating drills. Ore was hauled to the Golden Eagle mill, about a mile distant, with a 2½-ton Ford truck. The mill contains 16 stamps of a capacity of 35 tons per day, plate-amalgamation, and a Wilfley table. Crushing was to 35-mesh. At time of visit, 22 men were employed. For references to earlier reports on New York mine and Golden Eagle mill, see accompanying table of mines.

Nigger Boy Mine comprises 240 acres of patented land, former railroad land, in Sec. 1, T. 46 N., R. 7 W. It is owned by O. K. Wilson, San Diego, and is optioned by Lee DuBois, Yreka. From the Klamath River highway, a good road has recently been built up Ash Creek to this mine and beyond, by the Civilian Conservation Corps.

Old adit levels of a total length of 3700 ft. expose a flat vein at elevations varying from 135 ft. above Ash Creek to 650 ft. higher. The country rock is a metamorphosed sedimentary series now appearing mostly as a graphitic schist. The average dip of the veins is under 10°, and widths average about 2½ ft. with a 5-ft. maximum. The main vein is of white ribbon-quartz carrying free gold and auriferous pyrite. Some of the vein filling is white calcite, and this often carries free gold. Apparently the occurrence is somewhat similar to that at the Hazel or Jillson mine, a little over a mile to the northeast. At the Nigger Boy, roughly perhaps 50,000 or 75,000 tons of ore have been mined and milled, said to run about $30 per ton. This work was done in the years from 1891 to 1909, and from 1911 to 1915. Equipment, including a 6-stamp mill of 1000-lb. stamps, two compressors, track, cars, etc., was removed in 1921.

DuBois has been prospecting surface material with cuts and short adits. He finds that some of the country rock containing quartz stringers assays from $3 to $5 per ton. References to reports on earlier work at this mine are contained in the accompanying table of mines.

Norcal Mining Company is to be incorporated by E. G. Sundfelt, R. S. Fox and E. G. Lindstrom of Sawyers Bar, California, and Seattle, Washington. They are opening up a group of old mines in T. 39 N., R. 11 W., near Rollin, six miles south of Sawyers Bar. Included in the group are the Ida May, Klamath, Union-Central, Spears, and Wescoatt or Boss, a total of 18 or 20 claims and two or three mill sites. An effort is being made to block out sufficient tonnage in these mines to justify the construction of a central milling plant.

At the Central, a portable compressor has been installed, and 170 ft. of new workings have been driven; also 1100 ft. of old caved tunnels have been cleaned out. At the Ida May, 600 ft. of old tunnels have been cleaned out, and 100 ft. of new workings driven. At the Klamath, 600 ft. of old workings have been reopened. This work was being continued with a crew varying from 15 to 30 men at the time of visit in June, 1935.

A two-stamp mill has been put in working order for use as a pilot mill. It contains an ore-bin, crusher, and a Denver Sub-A-unit flotation cell. At time of visit, the fifth mill-test of 60 tons was being run. For power, a new hydro-electric generator developing 60 hp. to 70 hp. is in use.

Ore is found at the Union, Central and Klamath in a flat vein of banded quartz with widths of 6 ft. to 8 ft., dipping on the average 18° easterly. Two other veins of the same character and nearly parallel to the one mentioned are found. In places they are said to unite to form a large orebody. At the Ida May, farther down the mountain, a vein similar in character, but with the quartz crushed to small fragments, and with a large amount of gouge, is found. It is thought to be a faulted segment of one of the veins above. Country rock is graphitic schist; and a light-colored dike, possibly andesitic, is associated with the vein. This is locally called 'cab'. References to reports on former operations at these mines are contained in the accompanying table of mines.

Norma Mine is in Sec. 28, 29, T. 46 N., R. 8 W. A total of 240 acres of unpatented mining claims is held by Geo. J. Cottle of Walker post office, as follows: Norma mine, 3 claims; Royal, 4 claims; Edna, 3 claims; San Jose, 2 claims. He has been prospecting small quartz veins, a few inches wide, in diorite. Some of the work exposes small veins, a few inches wide, of heavy iron sulphide, probably carrying some copper, in the diorite. Several hundred feet of open cuts and adits have been driven.

O'Connell Gold Mines Incorporated is reported to have done some development work at the Homestake and Hogan mines, 12 miles northeast of Sawyers Bar; but these mines were idle when field work was done in that district, and they were not visited. References to earlier reports on them are given in the accompanying table of mines.

Oro Grande Mining Co. The following is quoted from State Mineralogist's Report XXVII, chapter for January, 1931:

> "The McKeen mine of this company is in Sec. 36, T. 40 N., R. 9 W., near Callahan or 31 miles from the railroad at Gazelle over a good road. Hugh McKinnie, Callahan, California, is president and R. D. McKinnie is secretary. The property comprises 480 acres of patented land at an elevation of 4000 ft. Plenty of water from Boulder Creek, and good pine, fir and cedar timber are available on the property. It was discovered in 1881; and was last worked in 1929. Four veins are known; but only one has been developed. This is a fissure vein of white quartz with pyrite. The pyrite forms about 10% of the vein filling, and the gold is in pyrite. The vein, of an average width of 2 ft. and a maximum of 5 ft., strikes S. 35° W., and dips 85° to the southwest. On the lowest or No. 1 tunnel level, 2825 ft. of drifting have been done; and on the No. 2 level, 220 ft. above, 2300 ft. of drifting. A raise connects the two levels at a point 1500 ft. from the portal of No. 1 tunnel. Levels above No. 2 are stoped out and caved. Between No. 1 and 2 levels, owners claim ore reserves of 30,000 tons of ore of a value of $8 per ton. They state that three pay shoots have a length of 250 ft. each, and that the No. 1 tunnel has been in a shoot for the last 75 ft. The vein has a gouge parting on both walls and breaks clean of country rock without difficulty in the shrinkage stopes.
>
> Equipment includes a compressor, capacity 500 cu. ft. of free air per minute, machine drills for both stoping and drifting, cars and track. In the mill are a Blake crusher, Hardinge ball mill, Dorr classifier, two 10-ft. amalgamating plates, K & K flotation machine. The capacity is 35 tons through 60 mesh in 24 hours, with an extraction of 90%. A laboratory test with cyanide is stated by Hugh McKinnie to have an extraction of 94 to 96%. He says that a production of $250,000 is recorded

> and that probably an equal amount additional has been produced but not recorded. The only recent milling was a test run of 10 days in 1929. Water power from Boulder Creek is used to drive the machinery. A mile of ditch and 1000 feet of 14-inch pipe supply 500 miner's inches with a 260-ft. head.
>
> Numerous cuts and small tunnels were observed on quartz veins on the slope of the hill to the northwest of the mine. As one climbs this hill the float changes from granodiorite, which forms the walls of the McKeen vein, to serpentine, showing that the deposit is very close to the contact. Pieces of float of white, aplitic-appearing material, with only scattered crystals of biotite, are common in places on the slope also."

References to earlier reports on this mine are given in the accompanying table of mines.

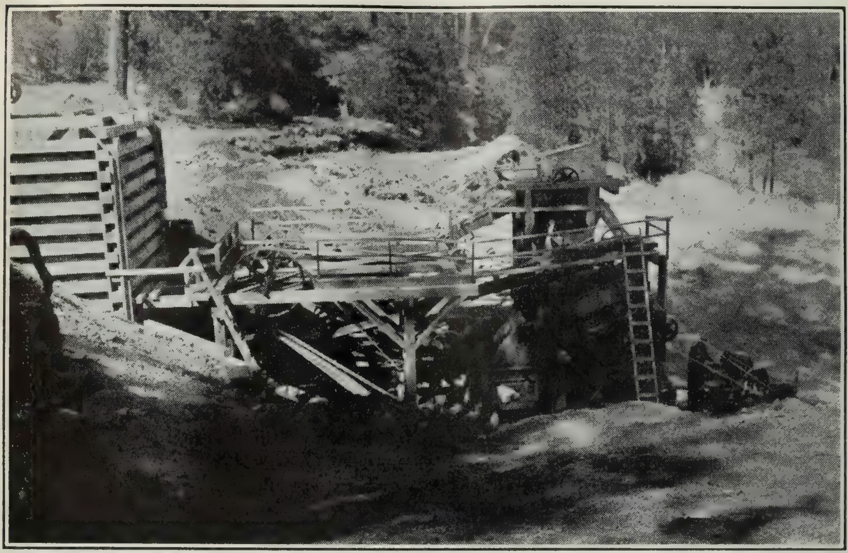
Paradise Group comprises 460 acres in Sec. 18, T. 15 N., R. 7 E., H. M., 10 miles southwest of Happy Camp, held by the estate of Reeves Davis, W. F. Davis, executor, 427 J Street, Sacramento. Three of the claims are patented under M. S. 5155, named San Francisco, Hunter's Paradise and Jolly Joker. Some gossan is found here; also larger bodies of schist mineralized with quartz seams and sulphides of iron and copper. Practically all of the surface material is heavily stained by oxides of iron derived from these sulphides. According to W. F. Davis, the deposit was to be extensively drilled and sampled, in 1934, with the idea that it may contain enough gold to pay by mining on a large scale with power-shovels.

Quartz Hill Mine. The following is quoted from State Mineralogist's Report XXVII, chapter for January, 1931, which contains also photographs of the mine and a sketch-map of the deposit:

> "It is a property of about 75 acres of patented ground in Sec. 16, T. 45 N., R. 10 W., at the Junction of Mill Creek and Scott River, near the town of Scott Bar. By road it is about 45 miles from either Yreka, the county seat of Siskiyou county, or Hornbrook on the main line of the Southern Pacific railroad from San Francisco to Portland. Thirty miles of this road are graded highway following the Klamath River; and the balance is fairly good. Patents are covered by Mineral Surveys, Lot 37, Marfield & Co. Placer Mine, and California Placer Mine, M. S. 3493. The owner is Harry G. Noonan, 2801 Jackson St., San Francisco. In 1860, or earlier, the mine was started as a hydraulic mine working on material eroded from the large system of quartz veins now exposed. A small mill of 10 stamps of 750 lbs. each was used in some of this early work, with amalgamation for the recovery of the gold. Present operators have worked the deposit for 25 years. Three or four men blast the hard quartz and schist and then hydraulic this broken material. Giants, discharging a large volume of water at a high pressure, wash the broken rock through a regular sluice with riffles in the bottom to catch the gold. The face of the pit is examined after each blast; and if any high grade is found it is sorted out and crushed in a small ball mill, run by a 5-hp. air motor, and equipped with amalgamating plates.
>
> Water is taken from Scott River by means of a ditch, seven miles long, with a capacity of 1500 miner's inches, and a head at the mine of 225 feet. There is no interruption in the supply of water in the dry season. A giant with a 5-inch nozzle is used in the pit, one with 4½-inch nozzle at the head of the sluice, and one with 4¾-inch nozzle to wash the tailings down the river. Present operations are roughly 25 or 30 ft. higher in elevation than the river. For drilling with the jackhammers, an 8-in. by 9-in. Ingersoll compressor driven by water power furnishes the air."

During 1935, Geo. A. Milne of Fort Jones, and George Noonan of Scott Bar have been leasing the property and working it by the same hydraulic method described. References to reports on earlier operations are contained in the accompanying table of gold mines.

Queen of Sheba Mine includes the old Eton mine and enough other patented land to make up a total of about 250 acres, in Sec. 10, T. 40 N., R. 9 W., M. D. M., between Etna and Callahan. It is being developed extensively by Goldberg & Sullivan, c/o Abe Goldberg, Etna. The method is the same as that used at the King Solomon. At time of visit, late in 1934, half a mile of trenches, 12 ft. wide, and as much as 20 ft. deep, had been excavated with a large diesel Caterpillar tractor with blade in front (bulldozer). These trenches were scattered over an area of 50 acres, and were designed to prospect a metamorphic zone, 600 ft. wide, in schistose sediments between serpentine and granodiorite. The contact-metamorphic zone contains garnets, sulphides of iron, and free gold. From the trenches, 1500 samples had been run through a new assay office at the mine. Each sample weighed 80 lbs., and was crushed and quartered to yield 4 lbs. for a test in an amalgamating muller. Tailing from each amalgamation test was assayed by the regular fire-assay. The oxidized zone is only a few feet deep here; and trenches deeper than that are excavated in fairly hard rock requiring blasting.



Queen of Sheba. Pilot mill near Etna.

A new test mill of a capacity of 30 tons in 24 hours of the soft, surface ore had just been built. It included a 125-ton coarse-ore bin, 7-inch by 10-inch crusher, 100-ton fine-ore bin, belt conveyor to double-deck vibrating screen, 3-mesh and 30-mesh. Undersize was treated in Gibson impact amalgamator. Oversize was ground in a 4-ft. by 4-ft. Union Iron Works ball-mill with open discharge, and bucket-elevator to deliver product to vibrating screen already mentioned, with which it was in closed circuit. Two Ford V-8 truck engines furnished the power. Other equipment included a Thew gasoline shovel with a $\frac{3}{4}$-yard dipper, a road plow, and a dump-truck. New flume of a length of 2700 feet had been built in the ditch-line from Sugar Creek to furnish 30 miner's inches of water to the mill.

Reeve Ranch Mine (placer) in Sec. 2, 11, T. 16 N., R. 7 E., H. M., two miles east of Happy Camp, is assessed to Miss M. A. Reeve, 729 Oak Street, San Francisco. It contains 211 acres, patented, and 70 acres of river channel. James T. Logan of Happy Camp is leasing the property, and is working it by the hydraulic method. The deposit consists of a 20-ft. depth of gravel on a low terrace of Klamath River, just above the present stream. Logan uses a hydraulic elevator to stack the tailing. Water supply comes from Indian Creek through $2\frac{1}{4}$ miles of ditch carrying 30 cu. ft. per second, and giving a head of 80 ft. at the mine. Pipe installation consists of 2500 ft. of 20-inch and 30-inch pipe to supply the hydraulic elevator (Joshua Hendy) and one No. 2 giant with 3-inch nozzle opening; also 2000 ft. of 11-inch and 13-inch pipe to supply two No. 2 giants with 3-inch nozzles. The hydraulic elevator raises gravel 14 ft. vertically to a sluice 42 inches wide by 24 inches deep by 108 ft. long with a grade of $3\frac{1}{4}$ inches to 12 feet. It has a 10-inch throat, and will lift a rock of that size. Water is ponded behind a timber dam, and part of it is returned to the elevator. This saves about three cubic feet of water per second, and keeps much of the silt out of the river. The sluice is rolled ahead on rollers of 6-inch pipe. In the spring of 1934, Logan was mining a 16-ft. depth of gravel, and stated that he was handling 1000 cu. yd. per 24 hours of gravel running 30¢ to 50¢ per cubic yard in gold (gold at $20) with a crew of seven to eight men. References to reports on earlier mining here are given in the accompanying table of mines.

Reno Group of two unpatented claims in Sec. 14, T. 44 N., R. 9 W., M. D. M., near Fort Jones, was being prospected in the fall of 1933 by the owner, N. J. Rowley of Fort Jones. A mile of new road had been built to the property. An andesitic dike intrudes the greenstone here. In the dike are stringers and bunches of quartz, a fraction of an inch wide up to an inch or two wide, also considerable pyrite in the fresher rock. The pyrite is oxidized in the surface material, coloring it brown. Both oxidized and unoxidized dike rock are stated to give pannings in free gold. Development work consisted of open cuts and a 10-ft. shaft. Four men were at work.

Reeve Ranch mine near Happy Camp. Hydraulic elevator.

On patented ground in the adjoining SE. $\frac{1}{4}$ Sec. 11, a 50-ft. crosscut adit runs N. 70° E. to strike a fracture zone dipping 45° to the east. It contains a mixture of gouge and quartz for a width of 3 ft. to 4 ft.

Short drifts, a raise and a winze were run on this years ago; and a small production of gold is said to have resulted.

Richardson Placer (DelNorte Mining Co.) is an old hydraulic mine in Sec. 1, T. 16 N., R. 7 E., near Happy Camp, on the opposite side of Klamath River. It is controlled by the Richardson Estate, W. W. Williams, Administrator, 486 California St., San Francisco, California. Of the 450 acres of patented ground, 50 acres were worked off years ago in a strip averaging 600 ft. wide. The banks left at the faces of these old hydraulic pits are 30 feet high, of which about a third appears to be overburden. Tunnels have been driven 200 and 300 ft. into these banks, and are entirely in gravel, which probably extends considerably farther. Local miners state that this gravel is of a commercial grade at the present price of gold ($35). To determine the grade accurately will require an extensive sampling campaign. A good water-right is said to be available at Elk Creek.

Riverside Placer is a claim of 20 acres in Sec. 32, T. 17 N., R. 8 E., H. M., held by E. D. Friend of Happy Camp. Two men were drifting and ground-sluicing in 1934. It has not been visited.

Roff Mine (Cory or Bridger mine) comprises one patented and three unpatented claims in Sec. 34, T. 41 N., R. 9 W., M. D. M., held by V. W. (Dan) Roff of Etna. An 18-inch vein of white quartz stained with oxide of iron, and carrying free gold is found in a metamorphosed sedimentary series of slates and cherts. Workings examined by the writer include an 18-ft. shaft and a 150-ft. drift adit at an elevation 100 ft. lower. In the shaft a 2-ft. width of quartz was exposed, which Roff stated would mill $9 (gold at $20) in free gold per ton. From the tunnel, the vein was stoped 40 years ago, when the property was known as the Cory mine. A cave in the face was being cleaned out; and Roff expected to drive the tunnel ahead for 15 or 20 feet to get under the ore found in the shaft. Roff describes other workings, all thought to be on the same vein as follows: At an elevation 40 ft. below the 150-ft. tunnel, the vein is exposed in a 100-ft. crosscut tunnel with 6 ft. of drifting, showing a width of 2 ft. At an elevation 120 ft. still lower is a 320-ft. tunnel that is thought to parallel the vein; and crosscuts might pick it up. On the next claim to the south is a 120-ft. tunnel, of which 100 ft. is drifting with the vein stoped out to the surface, 60 ft. above. On the second claim to the south is a 520-ft. crosscut adit that did not cut the vein on account of faulting. There is another adit at the south end of the group; but the portal has caved. The vein strikes northerly and southerly; and the dip is nearly vertical.

Ore from the shaft was being hauled to a mill about half a mile below, with a capacity of 8 tons per 24 hours. It contained a 7-inch by 9-inch crusher, Ellis mill, and plates for amalgamation, 4 ft. by 10 ft. Power was furnished by a Chevrolet automobile engine. There was also a 36-inch by 40-inch ball-mill, which had not been installed.

In Sec. 27 to the north, Roff holds a claim on a 50-ft. dike, probably andesitic, which he says averages $1.50 (gold at $20) per ton in gold. In a 50-ft. adit giving a depth of 30 ft., he says the average is 80¢, and for the last 10 ft. is $1. The dike can be traced for 10 miles, passing through the Eton claims, according to Roff.

Vol 31
1935

Salmon River Mines Co., Inc., E. C. Latchem, President, V. W. Peterson, Secretary, Callahan, California, is developing the Foster mine in Sec. 12 (?), T. 39 N., R. 10 W. It is reached by six miles of mountain trail from the end of the road up South Fork of Scott River near Callahan. Elevation is 6600 ft. A small mill was operated on the property years ago. New work has been done in a 950-ft. adit to pick up ore on the dip as shown by a survey of old workings. The adit is low enough to give 200 ft. of new backs on the vein. At time of visit, the face exposed a 5-ft. quartz stringer zone with vertical dip. According to E. C. Wood, who was in charge, a sample taken across the face assayed $12 per ton in gold. The footwall formation is a graphitic schist similar to that at Sawyers Bar; the hanging wall probably schist of a different kind. Three men have been at work. Equipment includes a compressor driven by a gasoline engine.

Schroeder Mine. The following is quoted from State Mineralogist's Report XXVII, chapter for January, 1931:

> "This mine in Sec. 17, T. 45 N., R. 8 W., is assessed to M. C. Beem and others of Fort Jones; but it has recently been reported sold to the Fidelity Metals Corporation. V. O. Bartoo is in charge, with I. B. Scrimger as mining engineer. The mine address is Fort Jones. The property is seven miles in an air line west of Yreka, and is reached over the old road to Fort Jones, which crosses a summit near the Mt. Vernon mine at an elevation of more than 5000 feet. Turning from this road at Deadwood Creek, the road to the mine starts climbing the mountain, and is very steep and winding for 3½ miles. In 1895, at least five veins, or possibly faulted segments of veins, had been exposed on this property; and thousands of feet of development work had been done from adits at several different elevations on the steep side of the mountain. Ore was being treated in a ten-stamp mill operated by steam power at the rate of 12 to 13 tons per 12-hour shift. In 1927, the *Sterling Gold Mining Co.* did some work here; but very little ore was produced.
>
> At the time of visit, an old tunnel on a vein called the Snowflake had been cleaned out and retimbered, so that the vein was exposed for a length of 100 feet. A width of 7 to 8 feet of shattered quartz heavily stained by iron oxides, has a strike of N. 80° E., and dip of 60° to 75° to the south. The operators stated that this gives an average assay of $8.80 per ton in free gold. The mill tunnel, called the 1600, is at an elevation 350 ft. below, measured vertically. The name '1600' comes from early-day measurements taken on the surface of the ground from some higher adit. When visited, this main level was 2000 ft. long, and was being driven ahead on a course of S. 45° W. to cut the Snowflake vein. The tunnel had just been passed through a quartz stringer zone, which carried some gold; and work was to be done on this later. A compressor driven by power from the lines of the California-Oregon Power Co. was being used on this work. The 10-stamp mill was not operating.
>
> Country rock is largely greenstone which has been highly altered. Some fine-grained granitic-appearing rock with crystals only about a millimeter in diameter was observed near the office, and some of possibly the same much silicified near the portal of the main tunnel. A dioritic intrusion was observed at a point higher on the mountain. The geology is somewhat complicated here; and apparently a complete geological examination would be of great benefit. This will require first the preparation of a good map on a large scale, based on a transit survey, of the surface and such workings as are open. With surface and underground exposures of veins, faults and formations carefully plotted and projected on such a map, a much better understanding of the vein system would result."

The mine is now owned by *Fidelity Metals Corporation,* Frank E. Jones, President, 1403 Santa Fe Ave., Los Angeles. This company did about 1000 ft. of new work on the lowest (1600) level, mostly in the fine-grained greenstone. Apparently this work is in the footwall of the main vein system; but the presence of faulting, and the distance of this level below the old productive levels (300 ft. measured vertically) make the exact position of this main vein system uncertain.

In the report quoted above, a quartz stringer zone is mentioned. This was later called the East & West vein, and roughly 200 ft. of drifting was done on it. A stope 60 ft. long, 60 ft. high and 5 ft. wide was made also. Some very good ore was found, but it was not as wide as the stope, and was diluted considerably by wall-rock in mining.

Although the mine was idle when visited, C. H. Van Nest, Box 275, Yreka, who was in charge, stated that the mill may be started to treat ore from the new discovery at the Katie May mine, 6½ miles distant. They are both near a good road running along the top of the ridge, 5000 to 6000 ft. in elevation, which continues on fairly easy grades to Yreka. Treatment in the mill is amalgamation on plates only. References to earlier reports on this mine are contained in the accompanying table of mines.

Sheba Mine is near the Buzzard Hill mine on a deposit of the same kind. It has been described in earlier reports under the name, *Outlook*. See accompanying table of mines. Present owners are Peter Grant and Alfred Effman of Happy Camp. Annual labor to hold the claims is all that has been done recently.

Short Bend Placer of 20 acres in Sec. 18, T. 16 N., R. 8 E., H. M., is held by Forest Moore and C. G. Lewis of Happy Camp. The adjoining River Bend claim of 20 acres is held by Moore only. They cover a low bar of Klamath River, about 2500 ft. long and 150 ft. wide, also river-bed of a somewhat larger area. In the Spring of 1934, Moore and Lewis were installing a scraper of ⅓-cu. yd. capacity to be pulled by a winch on a Fordson tractor. They planned to dump the scraper into a sluice with screen of ¼-inch mesh in the bottom, and to treat the undersize on tables similar to dredge-tables; also to screen out sizes below 14-mesh for further recovery of gold and platinum by methods under development. Moore and Lewis stated that 100 cu. yds. of gravel shoveled into sluices during the previous summer yielded a total of $94 (gold at $20), and that the recovery was not complete. Six prospect shafts 3 ft. to 4½ ft. deep were said to have given returns of $1.50 per cubic yard (gold at $35). Water for washing is pumped from the river.

Siskiyou County Mine comprises five claims, the old Bumblebee group in Sec. 31, T. 18 N., R. 7 E., H. M., just below the Classic Hill mine. The five claims are now held by Siskiyou County (address: Board of Supervisors, Yreka). They have been leased to individuals in the past, apparently for the purpose of having annual work performed. During the past few years, while annual labor has been excused by acts of Congress, they have not been leased. John Attebury leased the property in 1929, 1930 and 1931, working one season and two or three months of another season, and producing roughly $1800. A hydraulic pit on a terrace of Indian Creek is worked with a No. 2 giant supplied with water from Mill Creek under a 200-ft. head. The ditch is a mile and a half long and carries 1500 miner's inches. Attebury stated that he was not justified in properly equipping the property because it is leased for only one year at a time, and that amount of time is needed to recondition equipment. In his work only about half of the available head was used.

Siskiyou Metals Company did some work on Crapo Creek near Forks of Salmon in 1929 and 1930. At times of several visits to the district in later years, the property was idle.

Siskiyou Mines and Development Company issued a prospectus on a mine near Callahan, from Everett and Bremerton, Washington. Mark

F. Mendenhall is president and General Manager, and Wm. P. Alvik, 1107 Hewitt Ave., Everett, is Secretary-Treasurer. Apparently the mine is the *Salsbury* at the head of Mill Creek, south of Callahan, although this name does not appear in the prospectus. The mine has not been visited.

Soda Mint Mine comprises 40 acres in Sec. 29, T. 39 N., R. 3 W., leased from *Hewitt Lumber Co.,* by J. J. Murphy of Weed. From Castle Crags there is a dirt road up Soda Creek, then a rough road up Little Soda Creek, from the end of which the property is a mile up the mountain by trail. An effort has been made, by the driving of 1100 ft. of tunnels, to develop a body of low-grade gold ore large enough to mine with power shovels. Murphy states that he has obtained assays as high as $5.50 per ton with gold figured at $20 per ounce. The deposit is said to be 200 ft. wide. It was apparently originally a fine-grained igneous rock very thoroughly impregnated with pyrite in abundant, minute crystals. There are also tiny seams and vugs filled with quartz. The mass has been so thoroughly weathered and disintegrated on the surface that it now appears as a fine-grained sand of yellowish and reddish-brown color.

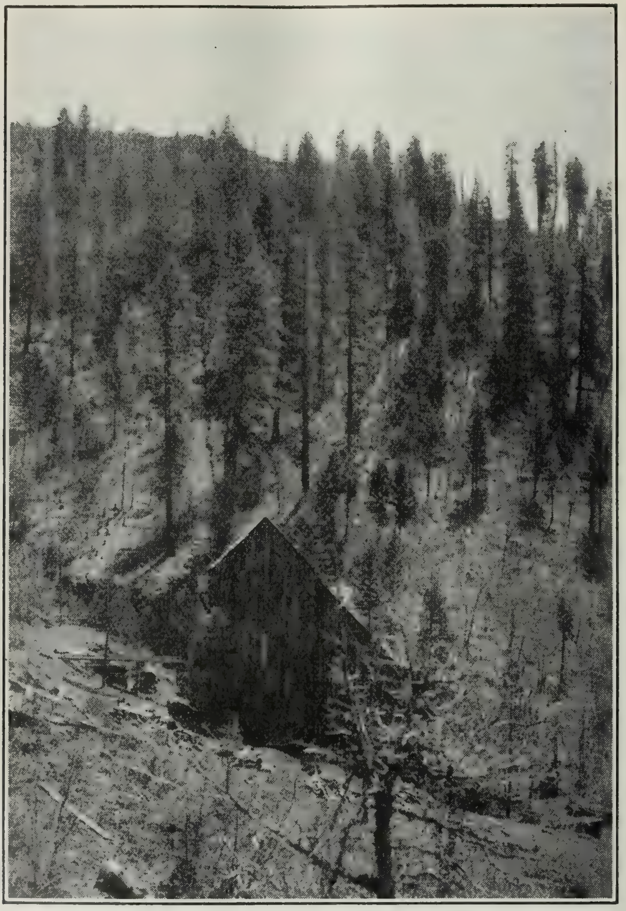
Sunnyside Placer in Sec. 1, T. 16 N., R. 7 E., a few miles northeast of Happy Camp, is owned by H. J. Barton of Yreka. For hydraulicking, water supply is taken from Cade Creek through two miles of ditch, giving a head of 150 ft. at the mine. There is one No. 2 giant using a nozzle with a 3-inch opening. A depth of 12 ft. of gravel is found on a high terrace, and considerable faulting is evident in the bedrock, making it irregular to mine. A little mining is done each winter by lessees.

Thompson Creek Mine in Sec. 15, 16, T. 18 N., R. 7 E., H. M., of seven unpatented claims, is held by S. K. Wood of Seiad and others. It is nine miles by trail, up Thompson Creek, from the Klamath River. According to Wood, a 2-ft. quartz vein carrying gold has been traced on the surface for a length of 7000 ft. Strike is east and west, and dip is vertical. It is developed by two adits, one a drift 270 ft. in length, the other comprising 100 ft. of crosscut and 140 ft. of drift. The second is 140 ft. lower in elevation than the first. Eight or 10 tons of ore said to assay $70 per ton are on the dump.

Turk Mine on the edge of Quartz Valley, about 30 miles by road southwest of Yreka, comprises 160 acres in Sec. 7, T. 43 N., R. 9 W., and Sec. 12, T. 43 N., R. 10 W. It is being operated by Banks & Maginnis, Inc., with J. P. Maginnis of Yreka in charge. An upper drift-level, giving backs of 90 ft., exposes the vein for a length of 400 ft., with a strike of N. 25° W., and dip 62° NE. Operators state that this work has exposed two shoots of mill-ore, one 35 ft. long, the other 60 ft. long, with average widths of 15 ft. to 16 ft. A 300-ft. crosscut has been driven toward another known vein, the Turk vein worked years ago, but this vein has not yet been reached. At an elevation 155 ft. lower, a second level is being driven. At time of visit, in April, 1935, it had been on the vein for 450 ft. and in an ore-shoot for 30 ft. Total length was 600 ft. The face showed a width of 8 ft. of quartz, gouge, and silicified greenstone. This level is 280 ft. higher in elevation than the mill, with which it is connected by a 700-ft., three-rail gravity tram.

A 65-ton bin is provided at the top of the tram, and primary crushing is done here by a No. 2 Gates gyratory crusher driven by a 25-hp. electric motor. Crushed ore is delivered to a 100-ton bin at the mill.

The mill contains 10 stamps of 1050 lb. each, plates for amalgamation, and a Wilfley concentrating table. Capacity is 34 tons in 24 hours. Other equipment includes a 310-cu. ft. air-cooled compressor driven by a 50-hp. motor, and a small blower for ventilation. Electric power is used throughout, a new line a mile and a quarter long having been built from the Morrison & Carlock mine.



Turk Mine on the edge of Quartz Valley. Mill and gravity tram.

The average crew comprises 15 men, of which 10 are employed in the mine. Allen Maginnis is mine foreman, and Wm. Maginnis is mill foreman and assayer. A third vein, called the Keenan, is known on the property, and a shaft has been started on it.

Underland Mine (Julia) of six claims in Sec. 28, T. 39 N., R. 3 W., is owned by J. J. Murphy of Weed, J. A. Barnett, and others. From Castle Crags, a dirt road goes up Soda Creek, then a rough road up Little Soda Creek to the mill, for a total distance of 6½ miles. The mine is a few hundred feet above on the mountain, and is reached by trail. With the mill, it is connected by an iron slide, through which the ore runs by gravity. The ore consists largely of gouge found in a seam from a foot and a half to four feet wide in slate. The bedding of the slate is practically flat, while the gouge has a dip of 30° to 40°. Several hundred feet of adits have been run at different levels, but these are now partly caved. In one of them a 3-ft. quartz vein carrying $7 per ton in gold (gold at $20) is stated to have been found. The property is now leased to J. A. Barnett and John Brewer, who are planning on running a new adit-level.

Equipment includes a two-stamp mill of 1000-lb. stamps, plates for amalgamation and a Wilfley concentrating table. Water power is used to drive this machinery, but is available for only a part of the year. Murphy states that table concentrates assay $90 per ton in gold (gold at $20 per ounce).

Victory Gold Mines Company is in Sec. 16, 17, 20, T. 40 N., R. 10 W,. M. D. M., on the South Fork of Russian Creek, three miles by road from Finley Camp. John Nefroney of Etna acquired title to this property, a year or two ago; but another change of hands has recently been reported. At time of visit in August, 1934, Nefroney was personally operating a new mill of a rated capacity of 24 tons in 24 hours. Ore was ground in a rod-mill and treated by amalgamation only; although the mill contains a concentrating table of the Wilfley type. Power was furnished by a 72-kw. hydro-electric generator installed in 1932. Shortage of water for this limited operations to only a part of the day. Nefroney stated that he did not have time to show the mine. C. A. Logan described geology and development work in State Mineralogist's Report XXI, p. 459; also the Advance on p. 430. Probably no large amount of development work has been done since that time. Ore for the run of the mill mentioned above was being delivered on mule-back.

White Bear Mine was being operated in 1934 by *Mayland Mining Company* (not incorporated.) A. H. Mayland, Calgary, Alberta, Canada, and S. W. Brethorst, Hoge Building, Seattle, Washington, are officials. Arthur J. Theis, Sawyers Bar, is manager. The mine is in T. 39 N., R. 12 W., M. D. M., two miles by road south of Black Bear mine; and 12 unpatented claims are held.

A quartz fissure vein carrying free gold and auriferous sulphides occurs here in graphitic schist. A decomposed dike (aplite?) of a width of a few feet accompanies the vein which consists of bands of white quartz alternating with bands of black schist. The vein averages 4 ft. in width with a maximum of 9 ft., strikes east and west, and has a vertical dip. It is developed by three adit-levels, of which the two upper ones in the oxidized zone have been worked out. The No. 3 level consists of a 300-ft. crosscut to the vein and 700 ft. of drifting.

At time of visit, in the Fall of 1934, the mill had just been remodeled, and contained a primary crusher, 9 inches by 12 inches, secondary crusher, 8 inches by 8 inches, Straub Challenge feeder, Straub rib-cone ball mill, 4 ft. by 3 ft., Dorr-type Simplex classifier, 27 inches by 16 ft., launder with riffles, two plates for amalgamation, 4 ft. by 6 ft., two Kraut flotation cells, two American Cyanamid flotation cells, wooden settling tank for concentrates, and drying pan. Power for the mill was furnished by a 50-hp. semi-diesel engine. There were also a 360-cubic foot Chicago Pneumatic air compressor driven by a semi-diesel engine, and machine drills.

Buildings included a small machine shop, cook house, mess hall and store room in one building, assay office with power crusher and grinder, office and storeroom combined, 8-room staff house, 3 dwellings, 4 bunk houses of one room each, and a barn. Fifteen men were employed.

White Dog Mine is one mile south of the Hansen, and is held by H. W. A. Docker of Sawyers Bar.

Wingate Hill Placer in Sec. 6, T 15 N., R. 7 E., H. M., eight miles southwest of Happy Camp, is held by O. Y. Anderson and Van Hoy. According to C. E. Reagan of Happy Camp, 10,000 cubic yards of gravel moved from this deposit by hydraulic mining, during the season ending in the Spring of 1934, yielded $2800. Some of the last gravel moved is stated to have averaged $1 per cubic yard. The property has not been visited. References to reports on earlier operations here are contained in the accompanying table of mines.

Yellow Rose Mine. The following is quoted from State Mineralogist's Report XXVII, chapter for January, 1931:

> "This mine in Sec. 20, T. 37 N., R. 9 W., is the property of *McCormick-Saeltzer Co.,* D. V. Saeltzer and R. A. Saeltzer of Redding, Clifford Saeltzer and Dorothea Sutton of San Francisco, and J. C. Boddicker of Carrville. It comprises the patented Yellow Rose of Texas, U. S. Mineral Survey, 3780, 14.91 acres; Yellow Rose mill site, 5 acres, and the Red Rose and Friendship claims. One can now ride to within four miles of this group over the very rough road built by the McNamara Mining Co. to the Nash mine. The last four miles are over a mountain trail. The Yellow Rose and the Dorleska are on the same system of dikes and veins, located on the divide between Salmon River and Coffee Creek, at an elevation of 6500 to 7000 feet. Main workings of the Yellow Rose are on the south side of this divide and those of the Dorleska on the north side. In 1912, MacDonald described this deposit as a serpentine mass cut by large and small lamprophyre (camptonite and kersantite) dikes. A 50-ft dike, strike N. 16° E., dip 75° W., cuts the serpentine near the schist contact, and parallel to it; and a fault zone is also parallel. MacDonald says, 'Near the Yellow Rose mine the east side of this dike contains hornblende prisms and is the "Crow's foot porphyry" of the prospector. The west side shows biotite and some quartz. * * * The ore deposits of these mines are similar. The fault zone is mineralized along the footwall of the composite dike, which is also locally mineralized where cut by side fissures. Rich shoots of clayey material which dip 45° N., characterize some of the fissure intersections.'
>
> Harry M. Thompson of Redding, who holds an option on the Yellow Rose, has two men at work on the property. This work is being done with the idea that the 'clayey' ore mentioned by MacDonald is the result of fault drag from quartz veins in the dikes. It is thought that former operators followed the line of least resistance with development work, and kept in the soft material, leaving the dikes, which are silicified and extremely hard, as an unbroken wall on one side of the working. New development work will break into these hard dikes in an effort to find the ends of quartz veins that have been sheared off by the faulting. Thompson states that since the visit of the writer to the mine, these ideas have been proved correct; and ore has been found in one of the dikes.
>
> At the time of visit, a tunnel about 200 ft. higher in elevation than the mill level was being opened. At the 600-ft. point in this tunnel there is a good exposure of a dike, strike due N., dip 81° W., in contact with the serpentine. The tunnel has apparently followed this contact for some distance; but it is so tightly timbered that this can not be well observed. Twenty-five feet to the east a second dike is seen in contact with the serpentine; and the gouge on this contact is said to pan gold.

Preparations were being made to follow this contact with a drift toward the Dorleska. All of the workings of the latter are closed by caving. An old 3½-ft. Huntington mill, which was driven by steam, stands on the Yellow Rose property.

Bibl: State Mineralogist's Report XXII, p. 26."

TABLE OF GOLD MINES AND PROSPECTS, SISKIYOU COUNTY

With References to State Mineralogist's Reports

Ranges east (E) refer to Humboldt Meridian.

Ranges west (W) refer to Mount Diablo Meridian.

Name of mine	Sec.	Twp.	Range	Remarks on location or owner	Elevation, feet	Area, acres	References
Abe Lincoln Placer				S. side Klamath opposite Portuguese	1,400		XXI, p. 462
Abel W. Cook, Placer				5 mi. above mouth Horse Creek	1,950	80	XXI, p. 462
Advance	16	40 N.	10 W.	John Nefroney, Etna, E. J. Miley and Edna McEwen	5,000	73½	XXI, p. 430; XIV, p. 825; see also Victory Gold Mines
Allgood & Castell Placer	12	11 N.	7 E.?	3 mi. SE. Somes Bar		40	XIV, p. 860
Amalgamated				See Gold and Nickel			
Amazon				2 mi. S. Henley	2,325		XIII, p. 386
Amback				See Humpback			
Ames				14 mi. S. Happy Camp	1,200	20	XXI, p. 431
Anderson Placer				See Joubert			
Ascondry Drift Placer	10	46 N.	9 W.	Lawrence Litchen	2,000	100	XIV, p. 861
Bailey	35	46 N.	9 W.		5,000		VIII, p. 624; XIV, p. 826; XXI, p. 431
Baker	15	44 N.	9 W.		5,000		XIV, p. 826; XXI, p. 431
Baldwin Group	18	40 N.	7 W.	J. C. King, Callahan	3,300	100	XXI, p. 431
Balfrey	28	41 N.	7 W.	M. H. Balfrey, Gazelle	4,500	800	See text this report.
Ball				See Ida May & California Con.			
Ball & Goforth				Cecilville District			XXI, p. 431
Ballingal Placer				6 mi. S. Callahan; R. F. Ballingal, Callahan	4,000		XX, p. 180; XXI, p. 464
Banks & Maginnis, Inc.				See Turk			
Banner				In Quartz Valley near Evans Gulch			XII, p. 277; XIII, p. 387
Bark House Creek Placer				Oak Bar District	2,000		XIV, p. 844; XXI, p. 464
Barandun	17	40 N.	7 W.	Simon Barandun, Gazelle & Orman Lutz, 5400 Hillen Drive, Oakland	4,000	160	XXVII, p. 29
Beaudry Placer	35	40 N.	9 W.	Madam Angele Bazet, 4 Laguna St., San Francisco	4,000		XIV, p. 844; Bull. 92, p. 99; XXI, p. 464
Belle Josephine Placer (Slide Creek)	14	39 N.	9 W.	A. E. Westover, Callahan	6,000	160	XIV, p. 844; XXI, p. 464
Bender	18	42 N.	11 W.		3,300	40	XIV, p. 826; XXI, p. 431
Bender				7 mi. S. Etna			XII, p. 277; XIII, p. 388
Better Yet				13 mi. NE. Scott Bar	3,010		XIII, p. 388
Big Bend Placer				2 mi. W. Oak Bar; H. J. Barton, James Allen, et al, Yreka	2,000	120	XXI, p. 464
Big Cliff		40 N.	10 W.	3 mi. SE. Finleys Camp	6,000	240	See text this report
Big Flat Placer	16	17 N.	7 E.	H. E. Attebery, Happy Camp	1,500	20	
Big Ledge	8	43 N.	9 W.	6 mi. NE. Greenview	3,000		XII, p. 277; XIII, p. 388; XIV, p. 826; XXI, p. 431
Big Rock Placer	36	18 N.	6 E.	J. V. Attebery, Happy Camp	2,000	20	
Big Slide Placer	19	46 N.	8 W.		2,000		XIV, p. 859; XXI, p. 465
Billups (Cleland, Brown & Billups)				11 mi. NE. Scott Bar	4,320		XII, pp. 279, 280; XIII, p. 288

Black Bear Quartz Mine		39 N.	11 W.	R. S. Phippeny, Sawyers Bar	4,200	70	VIII, pp. 620, 621; X, p. 656; XI, p. 431; XII, p. 277; XIII, p. 389; XIV, p. 826; XXI, p. 432. See text this report
Black Dike				See Blue Eagle			
Black Hawk	31	46 N.	7 W.?	5 mi. N. Gottville		40	XIV, p. 827; XXI, p. 432
Black Hawk, Hidden Treasure, Triangle				16 mi. W. Yreka, W. L. McLaughry and Fred Martin, Yreka	4,400		XXI, p. 432
Black Hawk				See Claughry			
Black Wolf Placer				Harry Walker, Clear Creek P.O.			
Blaylock & Schon Placer				Near Oak Bar	2,000		XXI, p. 465
Blind Lode	12	43 N.	10 W.	Estate of H. J. Diggles	3,500	17	XII, p, 278; XIII, p. 390; XIV, p. 827; XXI, p. 433
Bloomer Placer	33, 34	11 N.	7 E.	Bennett Co., Forks of Salmon	1,500	51	XI, p. 426; XII, p. 278; XIII, p. 390; XIV, p. 844; XXI, p. 465; VIII, p. 612
Blue Bar Placer	31	18 N.	7 E.	C. Scott Greening, Happy Camp	2,000	30	See text this report
Blue Channel Placer	19	48 N.	9 W.	Joe and Henry Slotik, Copper, Ore.	5,000	60	XXVII, p. 56
Blue Eagle	10	39 N.	10 W.	J. W. Preston, 350 Post St., San Francisco	6,500	560	See text this report
Blue Gravel Placer (Black Lead)	32	45 N.	7 W.		3,500		XIV, p. 844; XXI, p. 465
Blue Gravel Placer	35, 36, 1, 2	17 N. 16 N.	7 E. 7 E.	Frank Murree and John Whittaker, Happy Camp	2,000	100	See text this report
Blue Hill Placer	16	45 N.	10 W.		2,000	20	XIV, p. 845; XXI, p. 465
Blue Horn	24	45 N.	8 W.	R. D. Freshour, Yreka	4,000	40	See text this report
Blue Jay	11	47 N.	8 W.	Blue Jay Mining Co.	3,000	160	XIV, p. 827; XXI, p. 433
Blue Lead	26	42 N.	9 W.	L. H. Cory	4,000	40	XIV, p. 828
Blue Mine				See Schroeder			
Blue Nose Placer	5	13 N.	6 E.	Blue Nose Mines Co., Blue Nose P.O.			XXI, p. 465
Bonanza	14	46 N.	7 W.	Klondike Mining & Milling Co., J. P. Kleprock, Pres., Long Beach	3,000		XIV, p. 828; XXI, p. 433
Bonanza				2½ mi. E. Forks of Salmon, J. F. Wyrick and L. R. Pownell, Forks of Salmon	3,750	60	XXI, p. 433
Bonanza				On Grizzly Creek, tributary of Indian Creek	3,860		XII, p. 278; XIII, p. 390
Boot Placer	1	16 N.	7 E.	Mrs. T. M. Park, San Francisco	1,100	960	Address: 798 Post St.
Boss	16	39 N.	11 W.	W. H. Wescott, Rollin	3,900	20	XXI, p. 433; see "Norcal"
Boulder	30	29 N.	3 W.	J. M. Campbell, Dunsmuir	3,000		XXI, p. 434
Boulder Creek Placer (Fippen & Hayden)				3 mi. S. Callahan, Fippen & Hayden, Callahan	5,000	60	XX, p. 180; XXI, p. 465
Boulder Point Placer				Joseph Weeks, Scott Bar			XXI, p. 466
Bowersox Placer	2	11 N.	6 E.	W. P. Bowersox, Somes Bar	600	40	XIV, p. 845; XXI, p. 466
Bowser	11	47 N.	8 W.	C. L. Bowser, Hilt	5,000	40	See text this report
Boyle	8	45 N.	8 W.		5,000		X, p. 656; XI, pp. 444, 445; XII, p. 278; XIII, p. 390; XIV, p. 828; XXI, pp. 434, 453
Brazil Placer	11	45 N.	7 W.		3,000	80	VIII, p. 612; XIII, p. 391; XIV, p. 859; XXI, p. 466
Bridger				See Roff Mine			
Brown & Billhaps				4 mi. from mouth McKenny Creek			XII, p. 279
Brown & George Placer				14 mi. SE. Sawyers Bar, T. H. George, Cecilville			XII, p. 391; XIV, p. 845; XXI, p. 466
Brown Bear				See Cleaver; also Golden & Eveleth			
Bull Dog Placer	3	18 N.	6 E.?	H. E. Attebery, et al., Happy Camp			
Bumblebee Placer				See Siskiyou County Mine			
Bumblebee				On Bumblebee Creek			XII, p. 279
Burns Placer				See Joubert Placer			
Burton	1	44 N.	6 W.?	R. H. Burton, Fort Jones			XXI, p. 434

TABLE OF GOLD MINES AND PROSPECTS, SISKIYOU COUNTY—Continued

With References to State Mineralogist's Reports

Name of mine	Sec.	Twp.	Range	Remarks on location or owner	Elevation, feet	Area, acres	References
Buzzard Hill	4, 5	15 N.	7 E.	Buzzard Hill Mine, Inc., P. M. Tolman, Supt., Happy Camp	1,500	240	XXI, p. 434. See text this report
California Bar Placer	18	46 N.	6 W.	Vene Gold Bar Mining Co.	2,200	20	XIII, p. 391; XIV, p. 861
California Consolidated (Golden Ball)	16, 17	39 N.	11 W.	California Consolidated Min. Co., W. H. Young, Pres., Oakland	3,200	384	XII, p. 282; XIII, p. 402; XIV, p. 828
Cal-Oro Dredging Co.				See Gardella Dredge			
Campbell Placer	11, 13	43 N.	10 W.	H. A. Weed and others	3,000	522	XII, p. 279; XIII, p. 392; XIV, p. 845; XXI, p. 466
Cannon				6½ mi. SE. Forks of Salmon			XII, p. 279; XIII, p. 392
Cape Cod	18, 19	45 N.	7 W.		5,000	115	XIV, p. 829; XXI, p. 435
Cariboo				23 mi. W. Trinity Center	5,150		VIII, p. 614; XIII, p. 392
Carl & Shaw				5 mi. SE. Sawyers Bar			XII, p. 279; XIII, p. 392
Carpenter & Robertson Placer				Near Cecilville, S. Carpenter & E. M. Robertson, Cecilville			XIV, p. 845; XXI, p. 466
Cartwright & Phillips (Mountain Belle)				16 mi. NE. Yreka	3,500		XI, p. 445; XIII, p. 392
Cassadoga	2	47 N.	8 W.	J. L. Corbett, Hilt	5,500		XVII, p. 533; XXI, p. 435
C. B. & Q.				½ mi. S. Oro Fino			XIII, p. 393
Cecilville Placer (Sightman)				Near Cecilville	2,500	40	XIV, p. 845; XXI, p. 466
Central				See Union			
Central	35 2	48 N. 47 N.	8 W. 8 W.	C. R. Wiegel, Redding	4,000	140	XIV, p. 829; XXI, p. 435; XXVII, p. 30. See text this report
Challenge				2 mi. NW. Deadwood	3,720		XIII, p. 393
Champion	33	12 N.	6 E.	W. F. & J. A. Hunter, Orleans		180	XIV, p. 829; XVII, p. 533; XXI, p. 435
Chapman	30	40 N.	7 W.	J. & H. H. Chapman, Hornbrook, and T. L. Petersen	5,000		XX, p. 180; XXI, p. 436
Charter Oak				10 mi. SW. Yreka	4,700		XIII, p. 393
Cherry Hill	27	45 N.	8 W.	G. A. Reichman, Fort Jones	4,100	240	XXI, p. 436; XXVII, p. 31; XIV, p. 829. See text this report
China Creek Placer (Reeve)	5	16 N.	8 E.		1,300	40	XIII, p. 393; XIV, p. 845
China Point Placer	5, 6, 7, 8	16 N.	8 E.	C. E. Reagan, Happy Camp	1,500	195	See text this report
Classic Hill	36	18 N.	6 E.	C. Scott Greening, Happy Camp	2,100	310	VIII, p. 599; XI, p. 443; XIII, p. 394; XIV, p. 846; XXI, p. 466; see text this report
Claughry				14 mi. NW. Yreka	4,000		XIII, p. 394
Cleaver (Brown Bear or Golden & Eveleth)	14	39 N.	11 W.		4,800	140	XI, p. 433; XII, pp. 279, 283; XIII, p. 402; XXI, p. 436
Cleland				3 mi. above mouth McKenny Creek			XII, p. 280
Clyburn	8	46 N.	7 W.	S. F. Clyburn, Klamath River	2,000	70	See text this report
Collateral				1 mi. W. Yreka			VIII, p. 630
Collins Ranch Placer (Ambrose Min. Patent)	6, 7	16 N.	8 E.	W. E. Collins, Seiad	1,100	89	See text this report

Columbia	1	45 N.	10 W.	Adrian J. Fisher	5,500	23	XII, p. 280; XIII, p. 394; XXI, p. 437; XIV, p. 829
Commodore (including Good Enough and Insurance)	26, 27, 34, 35	46 N.	9 W.	H. J. Barton, Yreka	3,500	220	XIII, pp. 394, 403, 408; XXI, p. 437; XXVII, p. 31. See text this report
Condensed	12	38 N.	11 W.	W. H. Cady	2,400	60	XIV, p. 830
Connor	18	43 N.	9 W.	J. Connor	3,000	20	XIII, p. 395; XIV, p. 830
Consolidated Sciwash	6	44 N.	8 W.	H. Madison	3,200	90	XIII, p. 395; XIV, p. 861
Contact & Bonanza	19	46 N.	6 W.	B. G. Reedie, Yreka	2,100		XXI, p. 437
Conzetti Placer				In Cecilville District, G. A. Conzetti, Cecilville			XXI, p. 467
Cook, Abel W.				See under "A"			
Corbett	2	47 N.	8 W.	J. L. Corbett, Hilt	5,400		
Corey Bros.	29	40 N.	7 W.	Corey Bros., c/o George H. Corey, Callahan	5,000	80	XII, p. 280; XIII, p. 396; XXI, p. 437; XXVII, p. 32
Corey	21	40 N.	7 W.	Abe Goldberg, Etna			
Corey	30, 24	40 N. 40 N.	7 W. 8 W.	Corey Bros., c/o Geo. H. Corey, Callahan	5,000		XXI, p. 438
Cornish				On Big Humbug Creek			See text this report
Cory				See Roff			
Cosmos Mines Development Co.				See Hansen			
Crapo Placer	11	10 N.	7 E.	Bennett Co., Forks of Salmon	1,200	39	VIII, p. 612; XI, p. 427; XII, pp. 280, 282; XIII, p. 396; XIV, p. 846; XXI, p. 467
Crary				See S. R. Crary under "S"			
Crawfish Gulch	18	45 N.	10 W.	Sam Bratt, Oak Bar		40	XVII, p. 533; XXI, p. 438
Crawley	22	40 N.	8 W.		3,500		VIII, p. 629; XIII, p. 396; XIV, p. 830; XXI, p. 438
Croesus Placer (Hickey)				6½ mi. W. Sawyers Bar, John Teukert, Sawyers Bar		20	XXI, p. 467
Cronin Placer				See Gallia Placer			
Crumpton	2	16 N.	7 E.	See "Blue Gravel" in text		200	
Cub Bear and Blue Jeans	9	40 N.	10 W.	Siskiyou Syndicate, I. J. Luce, Pres., 618 2d Ave., Seattle, Washington	5,000	640	XXI, p. 438; XIV, p. 830
Cummings				See Oro Grande			
David Ledge				13 mi. NE. Scott Bar	3,100		XIII, p. 396
Davis Consolidated Mines (Placer)	2, 9, 10, 11, 15, 16	16 N.	7 E.	Estate of Reeves Davis, c/o W. F. Davis, 427 J St., Sacramento	1,200	603	XIV, p. 846, XXI, p. 467. See text this report
Deep Channel Placer (Taylor & Maplesden)	36	46 N.	11 W.	Deep Channel Mining Co., J. L. McKittrick, Pres., Portland, Oregon	1,500	40	XII, p. 293; XIII, p. 429; XIV, p. 861
Deer Lodge				6 mi. S. Sawyers Bar	4,050		XIII, p. 396
Del Norte				See Richardson			
Denny Placer	17, 20, 21, 29	40 N.	8 W.	Scott River Dredge Co.	3,200	400	XIV, p. 846
Dewey	6	41 N.	6 W.	F. A. Wright, 1744 Franklin St., Oakland	6,800	100	XIV, p. 831; XXI, p. 438; XXVII, p. 32. See text this report
Dick Morris Placer (Joe Ramus Placer)	35	46 N.	11 W.	J. B. Nowdesha and Mrs. S. D. Johnson, Hamburg Bar	1,500	59	XIV, p. 848; XXI, p. 469
Doggett Placer				Near Oak Bar	2,000		XXI, p. 469
Dollarite				G. H. Lindley, Seiad	4,000	80	
Doolittle Placer	5	17 N.	8?E.	In Happy Camp District, M. Doolittle		40	XIII, p. 404; XIV, p. 861
Double Eagle and Little Quartz	26	46 N.	9 W.	H. J. Barton, Yreka	3,000		XIII, p. 397; XIV, p. 831; XXI, p. 438
Dundee				14 mi. NW. Yreka	4,000		XIII, p. 398
Dunnigan Placer	20	12 N.	6 E.	36 mi. S. Happy Camp			XIV, p. 848; XXI, p. 469
Easter				In Humbug District, Frank Zollihofer, Yreka		20	XXI, p. 438
East Fork Ledge				5 mi. E. Callahan			XIII, p. 398

TABLE OF GOLD MINES AND PROSPECTS, SISKIYOU COUNTY—Continued

With References to State Mineralogist's Reports

Name of mine	Sec.	Twp.	Range	Remarks on location or owner	Elevation, feet	Area, acres	References
Eastlick Placer	7, 8	43 N.	9 W.	Reichman Mercantile Co., Fort Jones	3,000		VIII, p. 608; XIII, p. 398; XIV, p. 848; XXI, p. 469
Eli				4½ mi. W. Yreka			XIII, p. 398
Eliza	4, 5, 8, 9	45 N.	8 W.	R. H. DeWitt, Yreka	4,000		XIV, p, 831; XIX, p. 138; XXI, p. 439; XXVII, p. 32. See text this report
Elk Creek	3	45 N.	7 W.	Elk Creek Mining Co., J. E. Harmon, Secretary, Yreka	3,000	100	XIV, p. 831
Elk Creek Placer	15	16 N.	7 E.		1,100	60	XII, p. 281; XIII, p. 398; XIV, p. 861
Elliott Creek Mines Co.	18	48 N.	10 W.	Address, Roseburg, Oregon	3,000	450	See text this report
Elliott Placer (Golden Nugget)				1½ mi. W. Sawyers Bar	2,200	20	XIV, p. 848; XXI, p. 469
Ellston Placer	33	11 N.	7 E.	A. E. Ellston	1,200	30	XIV, p. 848
El Oro No. 3 Dredge				Near Yreka	3,000		Bull. 85, pp. 36, 37; XXI, p. 490
Empire Bar Placer	2	46 N.	8 W.		1,900	20	VIII, p. 589; XIV, p. 861
Empire	27, 34	41 N.	9 W.	J. W. Wright, Etna	3,500	60	See text this report
Empire				2 mi. N. Gottville	2,500		XII, p. 281; XIII, p. 399
Enterprise				2 mi. NE. Sawyers Bar, Geo. E. Townes and W. E. Tebbe, Weed	3,900	100	XXI, p. 439
Enterprise Placer	21	45 N.	10 W.	Hollis Anderson, Scott Bar	2,500	100	VIII, p. 623; see text
Espey Placer	25	47 N.	9 W.	Espey Mining Co., Seattle, Washington		50	XIV, p. 849
Eton				See Queen of Sheba			
Eureka and W. J. D. (Firebug)				6 mi. SW. Sawyers Bar, Dunphy Estate, Sawyers Bar and W. J. Durch, Rollin			XXI, p. 439
Evans Placer (Berry)				5½ mi. NE. Happy Camp, C. A. Evans, Marshall Crawford		20	XIV, p. 862
Evening Star				See Union			
Everill Placer	26	46 N.	11 W.	J. H. Everill	1,500	40	XII, p. 281; XIII, p. 400; XIV, p. 862
Fagundez				See Humpback			
Fairchild				Long Gulch near Hawkinsville	4,000		XXI, p. 439
Fairy Queen				Divide between Empire and Hungry Creeks			XI, p. 446; XII, p. 282
Falcon				11 mi. NW. Yreka	3,400		XIII, p. 400; XXI, p. 439
Fawcett Mines Co. (Pennsylvania Placer)	22, 23	48 N.	10 W.	S. K. Hine and L. B. Miller, 924 National City Bank Bldg., Cleveland, Ohio	4,500	210	XXVII, p. 57
Fidelity Metals Corp.				See Schroeder			
Fippen & Hayden				See Boulder Creek Placer			
Fir Tree Placer				1 mi. W. Forks of Salmon, Bennett Co., Forks of Salmon	1,500	20	XIV, p. 849; XXI, p. 470
Flag				On Sucker Creek in Humbug District			XIII, p. 401; XVIII, p. 297; XXI, p. 439
Fledderman Bros.	34	45 N.	7 W.		2,700		See text this report
Fleetwood and Nannie S. (Jackson)	5	45 N.	8 W.	W. of Humbug			XI, p. 446; XIV, p. 832; XXI, p. 439

Foster				See Salmon River Mines Co.			
Forks of Salmon River (Placer)	7, 8, 9, 16, 17, 18	10 N.	8 E.	Forks of Salmon River Mining Co.	1,300	520	XIV, p. 850
Forks Placer				At Forks of Salmon, Bennett Co.	1,200	51	XII, p. 287; XIII, p. 401; XIV, p. 849; XXI, p. 470
Fort Goff Placer	31	47 N.	12 W.	14 mi. W. Hamburg Bar, G. Martin		80	VIII, p. 596; XII, p. 283; XIII, p. 401; XIV, p. 850
Franklin	16	44 N.	9 W.		3,000	40	XIV, p. 832; XXI, p. 440
Franks & Moncton				See Osceola			
Frazier Placer				See Woodfill & Barry			
French Bar Placer	17	45 N.	10 W.	Z. E. Russell	1,700	20	XIV, p. 862
French Bar Placer	24	15 N.	7 E.	Harry D. Maltis, Happy Camp	2,000	20	
Galena				12 mi. NW. Yreka	4,000		XIII, p. 401; XXI, p. 440
Gallia Placer (Paddy Cronin)				4½ mi. W. Sawyers Bar, A. Jacquemart, 320 Market St., San Francisco	1,900	120	XXI, p. 471
Gardella Dredge				Near Yreka			XXVII, p. 56. See text this report
Gardner & Deming (Placer and Quartz)	7, 18	43 N.	9 W.	Weed & Gardner	3,000	150	XIII, p. 402; XIV, p. 850
Gearhart Placer				On Horse Creek, 4 mi. above mouth, H. J. Barton, Yreka	1,850	120	XIII, p. 402; XXI, p. 472
Geeshan & Kellner Placer	30	40 N.	11 W.		2,000	20	XIV, p. 850; XXI, p. 473
Gibson Bar Placer	6	46 N.	7 W.	Joe Davidson and J. J. Skehan, Gottville	2,000	20	XXI, p. 473
Gilfeather				4 mi. SW. Oak Bar, J. D. Nowdesha, Hamburg Bar, and J. J. White, Sacramento	3,000		XXI, p. 440; XXVII, p. 34
Gilta (Gold Hill)	12	9 N.	7 E.	G. A. Dannenbrink et al., Etna	3,000	60	VIII, p. 622; XI, p. 429; XIII, p. 407 (Hungry Hill); XIV, p. 833; XXI, p. 440. See text this report
Gold and Nickel	35 2	42 N. 41 N.	7 W. 7 W.	James F. Furlong, Fred Gould et al., Gazelle	5,000	200	XXVII, p. 34
Gold Ball Mining Co.		39 N.	11 W.	F. A. Gowing, Manager, Sawyers Bar	4,000	80	X, p. 657; XI, p. 432; XII, p. 282. See text this report
Gold Bank Placer				See Woodfill & Barry			
Gold Bug				See Lanky Bob			
Gold Bug	6	46 N.	6 W.	C. V. Clark, c/o Mrs. V. Barbour, Multnomah, Oregon		60	
Golden Age	4	45 N.	9 W.	E. W. Cooper and F. M. Kirkland, Walker P.O.	3,663	60	XXVII, p. 35
Golden & Eveleth				See Cleaver			
Golden Ball				See California Consolidated			
Golden Eagle Claim				See Golden Age			
Golden Eagle (Indian Creek)	11	44 N.	9 W.	Geo. A. Milne, Fort Jones	3,000		VIII, p. 625; XII, p. 282; XIV, p. 832; XXI, p. 440; XXVII, p. 35. See text this report
Golden Rule	10	47 N.	8 W.	R. G. Harrison, Klamath River	4,000	60	
Golden Rule and Scott Bar Placer				At Scott Bar, Turner Bros., Yreka		40	XXI, p. 474
Golden Seal	18	43 N.	9 W.		3,000		XIV, p. 832; XXI, p. 441
Golden West	15	39 N.	10 W.		7,000		XIV, p. 832; XXI, p. 441
Gold Hill				See Gilta			
Gold Hill Placer	28, 29	40 N.	11 W.	Bigelow Bros., Sawyers Bar	2,400		XIV, p. 850; XXI, p. 473
Gold Lead Placer	8	45 N.	10 W.	M. Andrews	1,600	20	XIV, p. 862
Gold Leaf	26	46 N.	7 W.?	J. M. Weaver, Yreka		80	See text this report
Gold Leaf Placer	8	45 N.	7 W.	Chas. Dillstrom, Yreka		20	XXI, p. 473
Gold Road	23	45 N.	8 W.	Kenneth K. Ash, Yreka	4,000	110	XXVII, p. 40
Gold Run (Hungry Hill)				10 mi. S. Forks of Salmon	2,000		X, p. 657; XI, pp. 429, 431; XII, pp. 283, 285; XXI, p. 441
Gold Standard, Inc.				See Mountain Laurel			
Goodenough				See Commodore; also Spencer			
Good Hope				S. of Gilta			See text this report

TABLE OF GOLD MINES AND PROSPECTS, SISKIYOU COUNTY—Continued

With References to State Mineralogist's Reports

Name of mine	Sec.	Twp.	Range	Remarks on location or owner	Elevation, feet	Area, acres	References
Goodman				On Indian Creek near Classic Hill, Joe Goodman, Happy Camp	2,500		XXI, p. 441
Gordon Placer	17	18 N.	8 E.	5 mi. NE. Happy Camp, C. Gordon		60	XII, p. 283; XIII, p. 403; XIV, p. 850
Grattan Mine				12 mi. S. Sawyers Bar			XII, p. 283
Gravel Mines, Ltd.	5, 8, 9	16 N.	8 E.	J. C. Moulton, Supt., Seiad	1,300	100	See text this report
Great Northern (Extension of Siskiyou)				6½ mi. NW. Yreka	2,900		XIII, p. 403
Green Mountain				2 mi. SW. Happy Camp	3,220		XIII, p. 403
Green Mountain				In Quartz Valley District			XI, p. 437
Green's Bar Placer	11	16 N.	7 E.	Steve Green, Happy Camp	1,000	40	
Grider Placer	10, 11	46 N.	12 W.	J. B. Grider	1,400	245	VIII, p. 600; XIII, p. 403; XIV, p. 851; XXI, p. 474
Grizzly Gulch	14	44 N.	9 W.		7,000		XIV, p. 833; XXI, p. 441
Grubstake Placer	16	17 N.	7 E.	C. H. Attebery, Happy Camp	1,500	20	
Gumboot	16	45 N.	9 W.	Jack McInnes and Philip McCool, Scott Bar	4,000	100	XIII, p. 404; XIV, p. 833; XXI, p. 441; XXVII, p. 41. See text this report
Guy Ford				See Jumbo			
Hadloff				13 mi. NE. Scott Bar	3,150		XIII, p. 404
Haley Placer (Halstead)	7	16 N.	7 E.?	10 mi. SW. Happy Camp, M. Doolittle		40	VIII, p. 601; XIII, p. 404; XIV, p. 851
Hammer Placer	36	46 N.	11 W.	Johnson et al., Hamburg Bar	1,500		XIV, p. 851; XXI, p. 474
Hansen	1, 12	9 N.	7 E.	Roberts & Hagland	2,500	60	VIII, p. 622; X, p. 657; XI, pp. 429-431; XXI, p. 442. See text this report; XIV, p. 833
Happy Home				See Maplesden			
Hard Luck Placer	9	17 N.	7 E.	H. Miller, Happy Camp	1,500	20	
Hardscrabble Placer	1, 12	44 N.	9 W.	J. D. Duane	3,000	20	XIII, p. 404; XIV, p. 851
Hardscrabble	16	40 N.	10 W.	A. M. Buley, E. J. Miley, Sr., Los Angeles, and John Nefroney, Etna	5,200	100	XXI, p. 442; XIV, p. 833
Hartstan				7 mi. SW. Etna			XIII, p. 405
Hathaway	11	40 N.	9 W.	Fred Salter, 317 S. Olive St., Los Angeles	3,500		XXVII, p. 42. See text this report
Hazel	36	47 N.	7 W.	Hazel Gold Mining Co., Rm. 456, 79 New Montgomery St., San Francisco	3,500	80	XIV, p. 833; XXI, p. 442; XXVII, p. 42. See text this report
Hegler				See Oregon			
Herndon Placer	17	46 N.	7 W.	A. C. Herndon, Hornbrook	2,000		XXVII, p. 58. See text this report
Hibernia				2½ mi. SE. Sawyers Bar			XII, p. 284
Hickey				8 mi. SE. Sawyers Bar, Ed. Hickey, Sawyers Bar	4,660	120	XXI, p. 443. See text this report
Hickey Placer	24, 25	40 N.	12 W.	Pike & Hickey	2,000	20	XIII, p. 405; XIV, p. 852
Hickox Hydraulic				15 mi. S. Cottage Grove			XIII, p. 405
Hicks	2	46 N.	7 W.				XIV, p. 834; XXI, p. 443
Highland (Old Highland)	12	39 N.	10 W.	Foster Bros.	6,500	60	XIV, p. 834; XXI, p. 443
Highland	9	40 N.	10 W.	Highland Mining Corp., 904 Garfield Bldg., Los Angeles	6,000	320	XXI, p. 443

Highland	25	46 N.	7 W.				XIV, p. 834; XXI, p. 443
Hiyou (Davis)	30	45 N.	8 W.	½ mi. NW. Deadwood, G. A. Reichman and W. H. Young, Fort Jones			XIII, p. 405. See text this report
Hiyou Placer				8 mi. NW. Fort Jones, G. A. Reichman and W. H. Young, Fort Jones		40	XIII, p. 405; XIV, p. 852. See text this report
Hoboken	21	45 N.	8 W.	Estate of H. J. Diggles	4,500	40	XII, p. 284; XIII, p. 406; XIV, p. 835; XVIII, p. 496; XXI, p. 444
Hogan				16 mi. SW. Etna	4,400		XXI, p. 445
Homestake		41 N.	10 W.	16 mi. SW. Etna, R. S. Taylor, Yreka	4,400		XXI, p. 444; XIV, p. 835
Hooper Hill (Preckel)	21	45 N.	10 W.	H. Preckel	1,800	20	XIV, p. 852
Hoozier Hill Placer (Willard Drift)	36	46 N.	11 W.	J. B. Nowdesha	1,500	20	XII, p. 294; XIII, p. 432; XIV, pp. 852, 857; XXI, p. 474
Huey Hill Placer	25	18 N.	6 E.	D. Huey	2,000	40	XIII, p. 407; XIV, p. 852. See text this report
Humpback (Fagundez)	8	39 N.	11 W.	Alice Fagundas	4,000	80	VIII, p. 619; XI, p. 432; XII, p. 281; XIII, p. 386; XIV, p. 835; XXI, p. 445
Hungry Hill (Gold Run)				8 mi. S. Forks of Salmon	3,350		XI, pp. 429, 430; XII, pp. 283, 285; XIII, p. 407
Hunter & Downey				5 mi. S. Sawyers Bar			XII, p. 285; XIII, p. 407
Hunter's Paradise				See Paradise			
Ida May				4 mi. S. Sawyers Bar, A. J. Ball, Rollin	3,700	54	XXI, p. 445. See Norcal Mining Co., also
Imperial Heights Placer				2 mi. W. Sawyers Bar, Ed. Hickey, Sawyers Bar	2,100	40	XII, p. 284; XIV, p. 852; XXI, p. 474
Independence	32	15 N.	7 E.	Buzzard Hill Mine, Inc., P. M. Tolman, Supt., Happy Camp	1,225	140	XXI, p. 446. See text this report
Indian Girl	14	46 N.	7 W.		2,300	40	See text this report
Insurance				See Commodore			
Inyo	2	45 N.	8 W.		3,000		XIV, p. 835; XXI, p. 447
Iron Dike	22	48 N.	8 W.	D. M. Watt, Phoenix, Oregon	4,000	80	See text this report
Ironsides	26	45 N.	8 W.		4,500		XII, p. 285; XIII, p. 408; XIV, p. 835; XXI, p. 447
Jack Lowden Placer				See Lowden			
Jehova				2 mi. NW. Yreka	3,000		XIII, p. 408
Jim's Seattle Placer	5	16 N.	8 E.	J. A. King, Happy Camp	1,100	20	See text this report
Joe Ramus	6	45 N.	10 W.	G. A. Milne, Fort Jones	1,500	60	XIV, p. 853
Johnson & China Paul	12	43 N.	10 W.		3,000		VIII, p. 826; XIV, p. 835; XXI, p. 447
Johnson & Lewis	18, 19	43 N.	9 W.	John J. Johnson and others, Etna	3,500	120	VIII, p. 626; XII, p. 285; XIII, p. 408; XXVII, p. 43. See text this report
Joubert Placer (Peterson)	33?	40 N.	11 W.	3 mi. S. Sawyers Bar, L. J. Joubert, Sawyers Bar	2,500	87	XXI, p. 474
Julia				See Underland			
Jumbo	1	39 N.	11 W.?	Guy Ford, Weed	2,900		XII, p. 285; XIII, p. 409; XIV, p. 840; XXI, p. 447. See text this report
Kanaka Hill Hydraulic	27, 33	16 N.	7 E.	Steve S. Green, Happy Camp	1,500	100	See text this report
Kangaroo	29	40 N.	7 W.		5,500		XIV, p. 836; XXI, p. 448
Katie May	24	45 N.	8 W.		4,000	20	XIII, p. 409; XIV, p. 836; XXI, p. 448. See text this report
K. C.				See Golden Age			
Keaton				9 mi. E. Sawyers Bar	4,400	100	See text this report
Keno Placer	24	15 N.	7 E.	Harry D. Maltis, Happy Camp	2,000	20	
Keynote	30	46 N.	6 W.	C. E. Weston, Yreka, Chas. G. Peterson, 1825 Oak St., San Francisco, Chas. Magill, Redding	3,000	120	XXI, p. 448
Kiernan				9 mi. SW. Edgewood	6,000		XIII, p. 410
King Jade	7	17 N.	7 E.	Harry D. Maltis, Happy Camp	2,000	120	See text this report
King Solomon	14	38 N.	12 W.	King Solomon Mines Co., Roy N. Bishop, Pres., 411 Crocker Bldg., San Francisco, or Black Bear P. O.	3,500	800	XIV, p. 836; XXI, p. 448. See text this report

TABLE OF GOLD MINES AND PROSPECTS, SISKIYOU COUNTY—Continued

With References to State Mineralogist's Reports

Name of mine	Sec.	Twp.	Range	Remarks on location or owner	Elevation, feet	Area, acres	References
King Solomon				12 mi. NW. Yreka	4,000		XIII, p. 410
King Tut	32	41 N.	7 W.	T. A. Lloyd, Gazelle	5,000	220	See text this report
Kinkaid				9 mi. SW. Callahan, John Kinkaid, Sawyers Bar	4,000	20	XXI, p. 448
Klamath				1½ mi. SW. Rollin, A. J. Ball, Rollin. See "Norcal" also	4,500	80	VIII, p. 620; XI, p. 432; XIII, p. 410; XXI, p. 448
Klamath Placer Co.	16	46 N.	7 W.		2,000	68	See text this report
Klamath River Gold Mining Co.	15	46 N.	7 W.	Klamath River Gold Mining Co.	2,000	20	XIV, p. 862
Klein Placer (Casey)	4	39 N.	11 W.	Woodfill & Luddy	3,000	50	XII, p. 286; XIII, p. 411; XIV, p. 853
Klondike Mining & Milling Co.				See Bonanza			
Knownothing				8 mi. SE. Forks of Salmon	3,075		VIII, p. 622; XI, p. 431; XII, p. 286; XIII, p. 411
Knownothing Placer	15	16 N.	7 E.	C. E. Reagan, Happy Camp	1,000		See text this report
Lango				16 mi. W. Yreka			XII, p. 286
Lanky Bob				5 mi. SE. Sawyers Bar, G. T. Salsbury, Etna	3,300		XXI, p. 449. See text this report
Last Chance				¼ mi. W. Oro Fino			VIII, p. 624; XII, p. 286; XIII, p. 411
Last Chance (Grattan)				6 mi. E. Forks of Salmon			XII, p. 283; XIII, p. 411
Last Chance (Stewart)				7½ mi. N. Fort Jones	3,225		XIII, p. 411
Lewis				¾ mi. N. Oro Fino			XIII, p. 412
Liberty				4 mi. S. Sawyers Bar	3,400		XII, p. 286; XIII, p. 412
Lima				4 mi. W. Yreka	2,400		XIII, p. 412
Lincoln, Abe, Placer				See under "A"			
Little Bonsa	9	45 N.	7 W.	C. W. Gordon, Yreka	3,600	30	XXI, p. 449; XIV, p. 836
Little Crumpton Placer	1	16 N.	7 E.	Clifford & Leonard Crumpton, Happy Camp	1,200		See text this report
Little Queen (Erno)				Mouth Evans Gulch in Quartz Valley			XII, p. 281; XIII, p. 413
Live Yankee				5 mi. S. Sawyers Bar			XI, p. 432
Livingston & Everton				In Happy Camp District, T. E. Ahlstrom, Ashland, Oregon			XXI, p. 450
Long Tom Placer	35	40 N.	11 W.	Judin Johnson, Sawyers Bar	2,400	140	XXI, p. 476
Lowden Placer	11, 12, 14	46 N.	12 W.	Ariel Lowden, Seiad	1,400	393	XXI, p. 476. See text this report
Lowden Placer	2 35	45 N. 46 N.	11 W. 11 W.	J. F. Lowden, Hamburg Bar	1,800	60	XIV, p. 853; XXI, p. 476
Lowden, Jack, Placer	13	46 N.	12 W.	S. R. Huey, Newcastle, Pa.	1,500	73	XIV, p. 852. See text also
Lucky Bob Placer	2	46 N.	7 W.	Joseph Freshour, Gottville	1,900	20	XII, p. 287; XIII, p. 413; XIV, p. 862; XXI, p. 477
Lucky John				On N. Fork Humbug Creek	3,000		XIII, p. 413
Lucky Strike	33	41 N.	10 W.	Lucky Strike Mining Co., T. Eagerly, Pres., Los Angeles	5,000	80	XIV, p. 836
Lucky Strike				See Osgood			
Lumgrey	22?	47 N.	8 W.	Calstrom & Stelik, Portland, Ore.	3,500		
Mabel				7 mi. NE. Scott Bar	4,875		XII, p. 287; XIII, p. 414
Magnitude				5 mi. W. Yreka	2,900		XIII, p. 414
Malloy (Oregonian)				3½ mi. NE. Sawyers Bar, Dan Malloy, Sawyers Bar	5,000		XII, p. 289; XIII, p. 419; XIV, p. 838; XXI, p. 450

Mann & Ross Placer (Reynolds Creek)	21	12 N.	6 E.	Ed. Mann & Nelson Ross, Orleans		100	XXI, p. 477
Maplesden Placer (Happy Home)	31	46 N.	10 W.	Maplesden Bros.	1,500	40	VIII, p. 594; XIV, p. 851; XXI, p. 477
Marrian & Goodale	15	40 N.	10 W.		5,500	80	XIV, p. 837
Mary Alma Placer	10	46 N.	12 W.	Carl T. Frey, Seiad	1,400	20	XXI, p. 477
Masonic Bar Placer	4	46 N.	12 W.	Walter M. Creed, Seiad	1,300	108	XXI, p. 477
Mat-a-pan	17?	45 N.	10 W.	M. O. Payne, Scott Bar		20	See text this report
Mattoon Placer	34	45 N.	9 W.	R. A. Mattoon, Fort Jones	3,600	60	XXVII, p. 60
Mayland Mining Co.				See White Bear			
McCann Placer				9 mi. S. Happy Camp, F. B. McCann, Happy Camp	1,000	20	XXI, p. 479
McClaughry	8	45 N.	8 W.		5,000		XIV, p. 837; XXI, p. 450
McConnell Bar				See Klamath Placer Min. Co.			
McCook Placer	1	45 N.	8 W.	Charles Benback, Yreka	2,660	24	XXI, p. 479
McGuffey Placer	16	45 N.	10 W.	T. G. McGuffey	1,700	40	XII, p. 287; XIII, p. 415; XIV, p. 853
McKeen				See Oro Grande			
McKenzie				5½ mi. N. Gottville, W. H. Herndon			XXI, p. 450
McMahon Placer	25	40 N.	9 W.	C. A. Crowley	3,500	40	XII, p. 287; XIII, p. 415; XIV, p. 863
Metropolitan				4½ mi. SE. Sawyers Bar			XII, p. 287; XIII, p. 415
Michigan-Salmon Hydraulic (Red Hill)				2 mi. SE. Forks of Salmon, Bennett Co., Forks of Salmon	1,300	600	XIV, p. 853; XXI, p. 479
Might, Wm.				Near Classic Hill	2,000		XXI, p. 450
Milich Placer	2	10 N.	7 E.	P. Milich	1,200	20	XII, p. 288; XIII, p. 415; XIV, p. 854
Miller Placer	34	44 N.	9?W.	Jackson & Biedenbeck		20	XIII, p. 415; XIV, p. 863
Miller				⅜ mi. NW. Oro Fino			VIII, p. 624; XIII, p. 415
Minerals Recovery Corporation, Ltd.				See text this report			
Mint				1½ mi. W. Yreka	3,000		XIII, p. 416
Monarch	8	39 N.	11 W.	G. R. Godfrey	3,300	40	XIV, p. 837
Monarch				15 mi. SE. Forks of Salmon, L. W. Godfrey, Sawyers Bar	3,500		XXI, p. 450
Montezuma Placer	20	40 N.	8 W.		3,400	20	VIII, p. 612; XII, p. 288; XIII, p. 416; XIV, p. 863
Morganza Placer	13	46 N.	10 W.	E. W. Morgan, Oak Bar	1,260	60	XXI, p. 480
Morning Star				13 mi. SE. Scott Bar	3,270		XIII, p. 416
Morrison & Carlock (Little Queen)	13	43 N.	10 W.	Geo. A. Milne, Fort Jones	2,800	60	XIII, p. 413; XIV, p. 837; XXI, p. 450; XXVII, p. 44. See text this report
Mosher & Lowell				On Horse Creek			XXI, p. 450
Mountain Belle				1 mi. up from junction of Eliza Fork with N. Fork Humbug Creek			XI, p. 445; XII, p. 288
Mountain King				12 mi. N. Orleans, D. C. Weaver, Orleans	4,000		XXI, p. 452
Mountain Laurel		39 N.	11 W.	Gold Standard, Inc., 2434 1st Ave., So., Seattle, Washington	3,800		VIII, p. 619; XI, p. 432; XXI, p. 451
Mountain Lily				In Salmon River District, G. A. Conzetti, Cecilville	6,000	140	XVII, p. 534; XXI, p. 451
Mount Bolivar				5 mi. SW. Callahan	4,620		XIII, p. 416
Mount Vernon	26	45 N.	8 W.	Kathryn J. Pfeiffer, c/o K. K. Ash, Yreka	4,430	110	XXI, p. 452; XXVII, p. 45; XIV, p. 837. See text this report
Muck-a-Muck Placer	18	16 N.	8 E.	4½ mi. E. Happy Camp, Grant Smith, 693 Mills Bldg., San Francisco	1,430		VIII, p. 598; XII, p. 288; XIII, p. 416

TABLE OF GOLD MINES AND PROSPECTS, SISKIYOU COUNTY—Continued

With References to State Mineralogist's Reports

Name of mine	Sec.	Twp.	Range	Remarks on location or owner	Elevation, feet	Area, acres	References
Mullen	2	40 N.	9 W.	M. P. Mullen, Gazelle, and Otto Schmale, Chico	3,000	60	XXVII, p. 47
Multum in Parvo Placer				5½ mi. W. Sawyers Bar, Wm. Wike & Samuel Mathis, Sawyers Bar	2,000	60	XXI, p. 480
Mystery				Near Black Bear			VIII, p. 622
Native Son Placer	13	10 N.	7 E.	M. L. Mills, Forks of Salmon	1,300	20	XIV, p. 854; XXI, p. 480
Nebraska				10 mi. SW. Yreka	4,300		XIII, p. 417
Nebraska	7	46 N.	6 W.	Geo. H. Dern, R. S. Stryker, Yreka	3,000	122	See text this report
Neil, Ben	10	44 N.	9 W.	B. Neil, Fort Jones	7,100	40	XIV, p. 826
Neilon & Putnam				4½ mi. SE. Sawyers Bar, Miles Neilon & W. Putnam, Sawyers Bar	3,500		XXI, p. 452
Nelson (Del Monte)				12 mi. NW. Yreka	4,260		XI, p. 446; XIII, p. 417
New Era Placer (Lower Siskiyou)	19	15 N.	7 E.		1,000	160	XXI, p. 480
New Hope Placer (Mattoon)	3	44 N.	9 W.	R. A. Mattoon, Fort Jones	3,200	19	XXVII, p. 60
New York	2	44 N.	9 W.	Geo. A. Milne, Fort Jones	3,300	77	XII, p. 289; XIII, p. 417; XXI, p. 452; XXVII, p. 47. See text this report
Nicolett				4 mi. S. Sawyers Bar			XII, p. 289; XIII, p. 417
Nigger Boy	1	46 N.	7 W.		4,000		XIV, p. 837; XXI, p. 452; XXVII, p. 47. See text this report
Nigger Hill Placer	20, 21, 28, 29	10 N.	8 E.	Bennett Co., Forks of Salmon	1,400	80	XII, p. 289; XIII, p. 417; XXI, p. 481
Ninety (Hibernia)				3 mi. S. Sawyers Bar	3,350		XII, p. 284; XIII, p. 417
Nolan Gulch Placer	14	39 N.	9 W.	Charles Crutchfield, Callahan	6,000		XXI, p. 481
Norcal Min. Co.		39 N.	11 W.	Near Rollin	5,000	400	See text this report
Nordheimer Placer	3	10 N.	7 E.	Nordheimer Mining Co., H. B. Morey, Sec., Menlo Park	1,100	60	VIII, p. 611; XIV, p. 854; XXI, p. 481
Norma	28	46 N.	8 W.	Geo. J. Cottle, Walker	3,000	240	See text this report
Northern California Dredge Co.	36	46 N.	11 W.		1,500		Bull. 57; XIV, p. 864; XXI, p. 490
Northern Calif. Goldfields				See Morrison & Carlock			
North Star				See Boyle			
Oak Bar Dredge				Near Oak Bar	1,800		XXI, p. 491
Oak Bottom Placer Syndicate	21, 32 6 1, 2 35, 36	12 N. 11 N. 11 N. 12 N.	7 E. 7 E. 6 E. 6 E.	Robert L. Younger, Somes Bar, California, or Medford, Oregon	600	480	XXI, p. 481
O'Connell's Gold Mines, Inc.							See text this report
Ohio	8	46 N.	6 W.		2,500	60	XIV, p. 838; XXI, p. 453
Ohio				7 mi. W. Yreka	2,900		XIII, p. 418
Old Indian	4	9 N.	8 E.	A. Nally	3,000	40	XIV, p. 838
Old Vet and Eclipse (Hossick & Brown)	10, 11	45 N.	8 W.		4,000		XIII, p. 418; XIV, p. 838; XXI, p. 453
Olive				7 mi. N. Fort Jones			XII, p. 289; XIII, p. 419
One Hundred Dollar				5 mi. NE. Sawyers Bar, Sam Wallace, Frank Smith, Wm. Perkins, Sawyers Bar	6,500		XXI, p. 453

O'Neill Ranch Placer	22, 27	46 N.	11 W.	B. J. Getchell, Hamburg Bar	1,500		XXI, p. 481
Orcutt Placer	30	39 N.	12 W.	Alvin Orcutt, Forks of Salmon	1,500	20	XXI, p. 482
Oregonian				See Malloy			
Oregonian				4 mi. N. Sawyers Bar			XII, p. 289; XIII, p. 419
Oregon (Hegler & Aldrich)	3	45 N.	8 W.	Ed. Mathewson	3,800		XI, p. 446; XII, p. 284; XIII, p. 405; XXI, p. 453
Oriental				½ mi. S. Rollin, John Joseph, Sawyers Bar	3,900		XXI, p. 453
Oro Grande (Cummings, McKeen or Shasta)	36	40 N.	9 W.	Oro Grande Mining Co., Hugh McKinnie, Pres., Callahan	4,000	480	XII, p. 280; XIII, p. 396; XXI, p. 454; XXVII, p. 48. See text this report
Oro Grande	10, 11	45 N.	8 W.	Trask & Corinson	3,500	100	XIII, p. 419; XIV, p. 838; XXI, p. 454
Osceola (Franks & Moncton)				5 mi. SE. Sawyers Bar, James Keaton, Sawyers Bar	4,500	60	XII, pp. 282, 289; XIII, p. 419; XXI, p. 454
Osgood (Lucky Strike)	16, 21	45 N.	7 W.	J. E. Hubbart, c/o J. C. Hubbart, Yreka	2,800	520	XIX, p. 138; XXI, p. 454; XXVII, p. 44
Outlook				See Sheba			
Overton	16	40 N.	10 W.	Overton Gold Mining Co.	4,000		XIV, p. 838; XXI, p. 455
Paddy Cronin				See Gallia			
Paine Placer				In Scott Bar District, Wm. Fridley, Scott Bar			XXI, p. 482
Paradise Flat Placer	29	40 N.	11 W.	Robert Younger	2,100	40	XIV, p. 863; XXI, p. 482
Paradise	18	15 N.	7 E.	W. F. Davis, 427 J St., Sacramento		460	See text this report
Paragon Placer	32	17 N.	8 E.	E. E. Friend, Happy Camp		20	
Parker	20 or 21	48 N.	11 W.	George J. Parker, Copper, Oregon	2,100	40	XXI, p. 482
Paymaster				4 mi. S. Sawyers Bar	4,300		XIII, p. 419
Pennsylvania				See Fawcett			
Peters				6 mi. S. Sawyers Bar	4,725		XII, p. 289; XIII, p. 420
Peterson Placer				See Joubert			
Phillips & Cartwright				8 mi. W. Yreka,			XII, p. 290
Piedmont				Gertrude G. Chick, 1070 Pine St., San Francisco. Mine near Cecilville			
Pilot Knob and Kearsarge (Midwinter & Modoc)	30	46 N.	6 W.	R. G. Reeder, Yreka	3,000	40	XVII, p. 535; XXI, p. 456
Pilot Knob	23, 24, 26	47 N.	7 W.	Pilot Knob Mining Co., T. K. Anderson, Sec., Gottville	3,000	310	XIV, p. 839; XXI, p. 455
Pine Grove	10	46 N.	9 W.		2,000		XIV, p. 854; XXI, p. 482
Pinkham				Evans Gulch in Quartz Valley			XIII, p. 420
Pitts				½ mi. W. Oro Fino			XII, p. 290; XIII, p. 420
Poker Flat Dredge				1 mi. S. Callahan	3,400		XXI, p. 491
Pond Water Placer	20	13 N.	6 E.	H. H. Albars, Blue Nose	600	20	XXI, p. 482
Porphyry Dike	18	40 N.	7 W.	Mr. and Mrs. Chas. Slater, Callahan	4,000	20	XXI, p. 456
Porters Bar Dredging Co.	6, 7	40 N.	8 W.	R. V. Hayden, F. D. and R. C. Sullivan, Callahan	3,000	350	XXI, p. 491
Portuguese Quartz				See Humpback			
Portuguese Placer	4	46 N.	12 W.	Henry Wood, Seiad, see Minerals Recovery Corp., Ltd., also	1,500		VIII, p. 595; XII, p. 290; XIII, p. 420; XIV, p. 855; XXI, p. 482
Poverty Point Placer	18	46 N.	9 W.	H. J. Barton, Yreka	1,800	200	VIII, p. 592; XIII, p. 420; XIV, p. 863
Prospect Hill	30	12 N.	6 E.				XXI, p. 456; XIV, p. 839
Providence	18	43 N.	9 W.		3,000		XIII, p. 421; XIV, p. 839; XXI, p. 456
Punch Creek				5 mi. NW. Yreka	2,850		XIII, p. 421
Quartz Gulch Placer				See Wingate Hill			
Quartz Hill	16	45 N.	10 W.	Harry G. Noonan, 2801 Jackson St., San Francisco	1,800	75	VIII, pp. 622, 623; XI, p. 447; XII, p. 290; XIII, p. 421; XIV, p. 839; XXI, p. 483; XXVII, p. 49. See text this report

TABLE OF GOLD MINES AND PROSPECTS, SISKIYOU COUNTY—Continued

With References to State Mineralogist's Reports

Name of mine	Sec.	Twp.	Range	Remarks on location or owner	Elevation, feet	Area, acres	References
Queen				10 mi. SW. Yreka	4,700		XIII, p. 421
Queen of Sheba	10	40 N.	9 W.	Abe Goldberg, Etna	4,000	250	See text this report
Rainbow				Near Hawkinsville, T. C. Quinn & Newton Gordon, Hawkinsville			XVIII, p. 733; XIX, pp. 58, 93; XXI, p. 456
Red Hill	4	45 N.	7 W.		3,500		XIV, p. 839; XXI, p. 456
Red Hill Hydraulic				At Gilta		160	VIII, p. 615; XII, p. 290
Reeder	8	46 N.	7 W.		2,600		XIV, p. 840; XXI, p. 456
Reeve Ranch Placer	2, 11	16 N.	7 E.	Miss M. A. Reeve, 729 Oak St., San Francisco	1,200	281	VIII, p. 597; XI, p. 443; XII, p. 291; XXI, p. 484. See text this report
Reliable and Extension				On Hungry Creek, 9 mi. from Coles Station			XII, p. 291; XIII, p. 422
Reno	14	44 N.	9 W.	N. J. Rowley, Fort Jones	3,000	40	See text this report
Renown	14	41 N.	7 W.	James Furlong, Gazelle	5,000	480	XXVII, p. 52
Richardson	1	16 N.	7 E.		1,100	450	See text this report
Riverside Placer	32	17 N.	8 E.	E. D. Friend, Happy Camp		20	See text this report
Roberts				4 mi. S. Sawyers Bar	3,600		XII, p. 291; XIII, p. 422
Robinson Gulch	18	40 N.	10 W.		2,500		XIV, p. 840; XXI, p. 456
Rocky Point Placer	32	45 N.	10 W.	Hicks & McCarthy, Scott Bar	1,800		XXI, p. 484
Roff				2 mi. NW. Cecilville	2,680		XIII, p. 428
Roff (Cory or Bridger)	34	41 N.	9 W.	V. W. (Dan) Roff, Etna	3,500	80	See text this report
Ronning	19	40 N.	7 W.	Southern Pacific Co., San Francisco	3,600		XXI, p. 457
Rough & Frye	30	12 N.	6 E.	C. Frye		40	XIV, p. 840
Rough and Ready Placer				Harry Walker, Clear Creek P.O.			
Rout				7 mi. S. Etna			XIII, p. 423
Roxbury Placer				3 mi. NW. Scott Bar, Roxbury Syndicate, c/o Geo. Milne, Fort Jones	1,600		XXI, p. 484
Ruby Basin				See Jumbo			
Rulon Placer				On Beaver Creek, Percy Rulon			XXI, p. 484
Russell Placer	30	13 N.	6 E.	Geo. Russell, Blue Nose P.O.			XXI, p. 485
Russian Hill Placer (Red Hill)	23, 24	40 N.	12 W.	Estate of A. Ahlgren, Sawyers Bar	2,000	80	XII, p. 276; XIII, p. 386; XIV, p. 855; XXI, p. 485
Rycroft Placer	14	39 N.	9 W.	S. Rycroft	6,000	60	XIII, p. 423; XIV, p. 855; XXI, p. 485
Saint Lawrence	12	43 N.	10 W.	A. G. Myres	3,500	20	XIII, p. 423; XIV, p. 840
Salmon River		39 N.	10 W.	Salmon River Mines Co., Callahan	6,600		See text this report
Salsbury	15	39 N.	8 W.	See Siskiyou Mines & Development Company			
Sanford & Edmundson Placer				Near Seiad, O. A. Sanford & T. A. Edmundson, Seiad	1,400		XXI, p. 485
Santa Teresa				On Hungry Creek			XII, p. 291
Sauerkraut Placer	34	11 N.	7 E.	Charles Lilly, Forks of Salmon	1,100	40	XIV, p. 855; XXI, p. 485
Schroeder	17	45 N.	8 W.	Fidelity Metals Corp., c/o R. A. Peabody, 2989 21st Ave., San Francisco	5,500		VIII, p. 626; X, p. 656; XI, p. 446; XII, p. 291; XIII, pp. 424, 425; XXI, p. 457; XXVII, p. 53. See text this report
Schuler Drift Placer	16	45 N.	10 W.	M. Schuler	1,700	20	XIII, p. 425; XIV, p. 863

Schuler Placer	1?	16 N.	7 E.	2 mi. NE. Happy Camp	1,100	60	XXI, p. 485
Scioc	13	43 N.	10 W.	S. F. Bentley et al., Fort Jones	3,500		XXI, p. 457
Scott Bar				See Quartz Hill			
Scott River Dredging Co.				Near Callahan			Bull. 57, p. 221; XIV, p. 864
Seiad Placer	11	46 N.	12 W.	T. K. Towne	1,400	60	XIV, p. 856
Seiad Placer Mines				See Lowden (Ariel Lowden)			
Shadows Creek Placer				Near Cecilville			XXI, p. 485
Sheba (Outlook)	4	15 N.	7 E.	Peter Grant & Alfred Effman, Happy Camp	2,000	80	XXI, p. 455; see text this report
Sheffield				4 mi. E. Sawyers Bar			XII, p. 291
Short Bend Placer	18	16 N.	8 E.	Forest Moore & C. G. Lewis, Happy Camp	1,100	40	See text this report
Short				10 mi. E. Cecilville			XII, p. 292; XIII, p. 426
Shumway Placer (Bonaly)				1 mi. E. Forks of Salmon Forks of Salmon River Mining Co., Flatiron Bldg., San Francisco	1,200	220	XII, p. 292; XIII, p. 426; XXI, p. 485
Siskiyou County Placer	31	18 N.	7 E.	Owner: Siskiyou County	1,900	100	See text this report
Siskiyou Dredging Co.	6, 25, 14	44 N. 44 N.	9 W. 8 W.		3,000	165	Bull. 57, p. 223; XIV, pp. 864, 865; XXI, p. 491
Siskiyou Gold Mines Co.				On Horse Creek 8 mi. above mouth. Address: 2045 E. 70th St., Chicago, Illinois	2,500	80	XXI, p. 457
Siskiyou Klondike Placer				In Oak Bar District		40	XIV, p. 856
Siskiyou Metals Co.							See text this report
Siskiyou Mine				7 mi. NW. Yreka	2,950		XIII, p. 426
Siskiyou Mines & Development Co.	15	39 N.	8 W.				See text this report
Siskiyou Mines Co. (Placer)	5, 6, 7, 18	16 N.	8 E.		1,200	1,500	XIV, p. 856; XXI, p. 486
Siskiyou River Bend Placer	9	46 N.	9 W.	A. C. Aiken, San Francisco	1,700	20	XXI, p. 487
Six-Mile Creek Placer				18 mi. W. Callahan, A. E. Westover, Callahan, or 480 Pine St., San Francisco	3,700	40	XXI, p. 487
Skelton	26	41 N.	9 W.	D. Skelton	4,000	20	XIV, p. 840
Slim Jim				5 mi. E. Sawyers Bar, G. T. Salsbury, Berkeley	3,000	20	XXI, p. 457. See text this report under "Lanky Bob"
Slumway Placer	3	10 N.	7 E.	Bennett Co., Forks of Salmon	1,150	40	XIV, p. 856
Smith & Merriam				4½ mi. SE. Sawyers Bar	3,360		XII, p. 292; XIII, p. 427
Smith				On French Creek			XII, p. 292
Snowflake (Bear Den) and Little Gem				4½ mi. SE. Sawyers Bar, James Cavanaugh, Rollin	3,000		XXI, p. 457
Soda Mint	29	39 N.	3 W.	J. J. Murphy, Weed	3,500	40	See text this report
Spears				See Norcal Min. Co.			
Specimen	15	40 N.	9 W.	W. Ellis	3,500	60	XIII, p. 427; XIV, p. 840
Spencer (Goodenough)				12 mi. NW. Yreka	4,500		XI, p. 445; XIII, p. 427
Squaw Gulch Placer	1	40 N.	9 W.	D. L. Jones	3,420		XIII, p. 427; XIV, p. 857; XXI, p. 488
S. R. Crary (Quartz and Placer)				S. R. Crary, Walker P.O.		80	XXI, p. 487
Star	12	43 N.	10 W.	F. Star	3,500	20	XIII, p. 428; XIV, p. 841
Steel				Evans Gulch, Quartz Valley	3,550		XII, p. 292; XIII, p. 428
Stenshaw Placer	28, 29	13 N.	6 E.	Samuel Stenshaw, Blue Nose P.O.		98	VIII, p. 604; XXI, p. 487
Sterling Gold Mining Co.				See Golden Eagle & Schroeder			
Sterling				9 mi. W. Cole's Station			XI, p. 446; XIII, p. 428
Sterling				13 mi. NW. Fort Jones			XIII, p. 428; XIV, p. 841
Sturn (Colby)	2	16 N.	7 E.	G. H. Compton	1,200	200	XIV, p. 857
Sugar Creek Mining & Milling Co.				See Hathaway			
Sugar Hill (Quartz and Placer)	36	40 N.	9?W.	5½ mi. SW. Callahan	4,800	40	VIII, p. 611; XIV, p. 864; XXI, p. 488

TABLE OF GOLD MINES AND PROSPECTS, SISKIYOU COUNTY—Continued

With References to State Mineralogist's Reports

Name of mine	Sec.	Twp.	Range	Remarks on location or owner	Elevation, feet	Area, acres	References
Sundown	19	47 N.	7 W.	Denver Mining Co., C. A. Von, Pres., Denver		60	XIV, p. 841
Sunnyside Placer	1	16 N.	7 E.	H. J. Barton, Yreka	1,100		See text this report
Sunshine				Sucker Gulch, Quartz Valley	3,110		XIII, p. 429
Superior Consolidated Mines Co.				See Johnson & Lewis, Morrison & Carlock, and New York			
Swedish American Mining Co.				See Commodore			
Taft	30	11 N.	8 E.	C. Taylor	2,800	40	XIV, p. 841
Teddy-Avalon	18	47 N.	7 W.	E. J. Durkee		40	XIV, p. 841
Ten Eyck Placer Mines, Inc.	28	12 N.	6 E.	W. T. Tyler, Sec., 715 Bryant St., Palo Alto		80	VIII, p. 605; XIII, p. 430; XIV, p. 857; XXI, p. 488
Thomain Placer	5	39 N.	11 W.	F. and C. F. Thomain	2,600	20	XIV, p. 857
Thomas Placer	29	14 N.	6 E.	Thomas Bros., Blue Nose P.O.			XXI, p. 488
Thompson Creek	15	18 N.	7 E.	S. K. Wood, Seiad			See text this report
Tiger				Hull Gulch, Quartz Valley	3,250		XI, p. 437; XIII, p. 430
Trail Creek	12	39 N.	10 W.	Trail Creek Mining Co., Geo. A. Foster, Pres., Callahan	7,200	100	XIV, p. 841
Trust Buster	10	47 N.	8 W.	J. L. Corbett, Hilt	4,500		
Turk	12	43 N.	10 W.	Banks & Maginnis, Inc.	3,500	160	See text this report
Twan & Hannan	30	12 N.	6 E.	Twan & Hannan		40	XIV, p. 842
Two and a Half (Walker Placer)	20	40 N.	7 W.		4,000		XIV, p. 857; XXI, p. 488
Uncle Sam Consolidated Quartz Mine	3, 10	39 N.	11 W.?	S. P. Tillman	5,000		VIII, p. 619; XI, p. 433; XII, p. 293; XIII, p. 431; XIV, p. 842; XXI, p. 458
Uncle Sam				12 mi. NW. Yreka	3,600		XIII, p. 430
Underland	28	39 N.	3 W.	J. J. Murphy et al., Weed	4,000	120	See text this report
Union (Central or Evening Star)				1 mi. S. Rollin, Rollin Mining Co., c/o Ben Daggett or Leslie Daggett, Black Bear	3,900	40	VIII, p. 620; XII, p. 281; XIII, p. 400; XXI, p. 458. See "Norcal" also
Vesa Creek				12 mi. NW. Yreka, Harry, Joseph and E. Davidson			XXI, p. 459
Victoria	6	39 N.	3 W.	L. H. Brown, Dunsmuir	4,000		XVII, p. 535; XXI, p. 459
Victory Gold Mines	16, 17, 20	40 N.	10 W.	John Nefroney, Etna	4,000	220	XXI, p. 460. See text this report
Volcano				Evans Gulch, Quartz Valley	3,200		XII, p. 293; XIII, p. 431
Wanda				7 mi. SE. Forks of Salmon, O. L. Palmer, Forks of Salmon	2,500	60	XXI, p. 461
Welch & Bradley Placer				On Beaver Creek			XXI, p. 489
Wescoatt				See Norcal Min. Co.			
Whistle Bar Placer	29	40 N.	11 W.	Ed. Kearns, Sawyers Bar and Robert Kearns, San Jose	2,100		VIII, p. 616; XIV, p. 864; XXI, p. 489
White Bear		39 N.	12 W.		4,000	20	XIV, p. 842. See text this report
White Dog				1 mi. S. Hansen Mine			See text this report
White Elephant					4,140		XIII, p. 431

Whittaker	2	16 N.	7 E.	See Blue Gravel		80	See text, Blue Gravel
Wicks				12 mi. NW. Fort Jones	6,200	40	XIV, p. 842
William Burns Placer				See Joubert			
Williams	32	40 N.	9 W.	R. D. Williams, Callahan	6,000		XXVII, p. 54
Williams Point Placer	17	16 N.	8 E.	Mrs. M. A. Fowler, Happy Camp			
Wiliard Placer				See Hoosier Hill			
Wilson Bros.				3½ mi. S. Sawyers Bar, Wilson Bros., Sawyers Bar	3,500		XXI, p. 461
Wilson Placer	29	45 N.	8 W.	F. L. Wilson	3,500	40	XIII, p. 432; XIV, p. 864
Windeler Placer	20	40 N.	11 W.	J. C. Windeler	3,000	20	XIV, p. 858
Wingate Hill Placer	5, 6	15 N.	7 E.	Anderson & Van Hoy, c/o O. Y. Anderson, Happy Camp	1,000		VIII, p. 601; XII, p. 294; XIV, p. 855; XXI, p. 483. See text this report
Winterings				See Big Cliff			
Wood & Fehely	4	46 N.	12 W.	Wood & Fehely	1,300	60	XIII p. 432; XIV, p. 858
Woodfill & Barry Placer				1 mi. S. Sawyers Bar, J. Woodfill and C. J. Barry, Sawyers Bar	2,150	80	XXI, p. 489
Wood				On Thompson Creek, 10 mi. above mouth. Sam K., Stanley and Mrs. J. C. Wood, Mrs. Lena Hibbard and E. L. Brier, Seiad		120	XXI, p. 461
Wright & Fletcher	7, 8	43 N.	9 W.	Wright Bros.	3,000	80	VIII, p. 609; XII, p. 294; XIII, p. 433; XIV, p. 858
Yellow Jacket				7 mi. W. Walker			XIII, p. 433
Yellow Rose	20	37 N.	9 W.	McCormick Saeltzer, D. V. Saeltzer et al., Redding	6,700	60	XXII, p. 26; XXVII, p. 55. See text this report
Zarina	33	41 N.	10 W.	Zarina Mining Co., J. W. Harris, Supt., Etna	6,500	100	XIV, p. 842

GRANITE.

Good quality granite occurs on Craggy Mountain in T. 41 N., R. 8 W., and in Sec. 1, T. 41 N., R. 9 W., also in T. 40 N., Rs. 8 and 9 W. This has been used locally in a small way for building blocks and monuments. The deposits are all a long distance from railroad.

Bibl: Cal. State Min. Bur. Bull. 38, p. 54.

IRON.

Float iron ore is mentioned as occurring in Sec. 10, T. 46 N., R. 10 W.

Bibl: Cal. State Min. Bur. Bull. 38 p. 304.

LEAD.

On the *Fippen & Hayden Placer* (see under Gold Placer Mines), in the Callahan district, an adit of unknown length was run, many years ago, to prospect for lead. A small amount of good galena ore was brought out of this adit and dumped. In 1924, M. E. Gardner sluiced off the soil overburden and exposed the edge of the vein in place above the old adit. The exposed section is about 30 feet long and the width of vein is from a few inches to one foot. It consists of barite, carrying lumps and stringers of galena. Assays of the ore indicate a high lead content, sufficient to make the best samples a good shipping ore, and with a fair content of silver. Ore could be concentrated by jigging. Gazelle, the nearest railroad point, is 27 miles distant by road. This prospect is idle.

Other prospects of lead ore have been reported in the region eight to ten miles east of Callahan near the Gazelle road, but so far as could be learned, the float found there had not yet been traced to the vein, although some prospecting was going on in the late summer of 1925.

Siskiyou Lead Mine, the patented NE$\frac{1}{4}$ Sec. 29, T. 41 N., R. 7 W., 15 miles west of Gazelle, is the property of M. H. Balfrey of Gazelle. Evans and Mitchell were leasing at the time of visit. A crosscut adit cuts the vein at a distance of 70 ft. from the portal, giving a depth of 35 feet. Galena shows in spots in a vertical mineralized zone reaching a width as great as 12 ft. in places. A drift has been driven on this for 100 ft. Two shafts on the vein, reaching to depths of 50 ft. and 80 ft. below the surface were full of water to the tunnel level. Lessees state that 600 tons of ore on the dump assay 8% lead, 2% zinc, and $1.50 per ton in gold. The country rock is andesitic, some of it coarse enough in grain to approach diorite. A small mill manufactured by the Sacramento Gold Mill Co. was being installed. It consists of four stamps, of about 35 lbs. each, mounted on springs to give force to the blow. A jaw crusher, 6 in. by 8 in., will crush the feed for the mill. There are also two concentrators, 5 ft. by 7 ft., similar to Wilfley tables, but made by the same company as the mill. A 30-hp. gasoline engine will drive the outfit.

LIMESTONE

Large deposits of limestone and marble occur in Siskiyou County, but many of them are remote from present railroads. Those nearest to transportation are in the area of Devonian rocks just west of Gazelle. For local use in Scott Valley, deposits near Etna Mills, Greenview and Callahan have been worked in a small way. An area of Paleozoic and possibly pre-Paleozoic rocks with outcrops of limestone here and there extends from near Callahan northward for some 25 or 30 miles.

Marble occurs in large deposits in a belt running west of Etna Mills along the east slope of the Salmon Mountains, the Grider Mountains and past Thompson Creek. Should the demand ever arise, and means of transportation be provided, Siskiyou County could supply nearly any demand for limestone. The two deposits described below are the only ones from which production has recently been reported.

Hathaway Limestone Quarry, owned by Hubert Hathaway of Etna Mills, is in Sec. 9, T. 41 N., R. 8 W. The limestone outcrops on patented agricultural land in an area of about two acres to a height of 60 to 100 feet, and was mined in an open quarry. The last limestone, about 300 tons, was ground in 1929, under the supervision of A. S. Hathaway, who has since died. Dry grinding was done in a single stage to a maximum size of $\frac{1}{8}$ inch in a Day hammer-mill, made in Knoxville, Tennessee. A Fordson tractor furnished the power. Ten to 15 tons were ground per 8-hour day with a crew of four men, including a truck driver. Prices received were $4 per ton at the quarry, or $6 per ton delivered to points in Scott Valley. Hubert Hathaway does not plan any further production, and the hammer-mill is for sale. This is the same quarry from which Wm. Werst of Etna Mills produced limestone a few years ago. No analysis of this limestone is available. It is probably very similar to that of the Mt. Shasta Lime Co., an analysis of which is given below.

Mt. Shasta Lime Company is a partnership of W. J. Chastain of Gazelle and H. A. Craig. The property, four miles west of Gazelle by a good dirt road, comprises 760 acres in Sec. 7, T. 42 N., R. 6 W., and Sec. 12, T. 42 N., R. 7 W. Of this 460 acres are patented and the balance held by mineral locations. The limestone is mined in an open quarry and burned in a vertical kiln burning wood. The capacity is seven tons per day of 24 hours, and seven men are required when the kiln runs steadily. An average of 200 to 300 tons of lime per year is sold, but the kiln has been operated as much as seven months in one year. The last lime sold brought $20 per ton f.o.b. Gazelle packed in boxes holding half a barrel each. Cost of boxes was 44¢ per bbl. In the adjoining Sec. 6, T. 42 N., R. 6 W., W. J. Chastain and B. B. McCoy own 270 acres of land on which there is another large limestone deposit.

The following analysis from the above quarry was furnished by W. J. Chastain, who stated that it was made by Smith-Emery, No. 69,069:

Silica (SiO_2)	0.18%
Alumina (Al_2O_3)	0.10
Iron Oxide (Fe_2O_3)	0.20
Lime (CaO)	55.26
Magnesia (MGO)	0.27
Loss on ignition	43.76
	99.77%
Calculated ($CaCO_3$)	98.65%

Following are the locations and ownerships of some of the larger limestone deposits of Siskiyou County which are fairly close to existing roads:

T. 41 N., R. 8 W.

Sec. 9. See under Hathaway above.
Sec. 20, SE¼, Public domain.
Sec. 29, N½, Southern Pacific Land Co., Southern Pacific Bldg., San Francisco.
Sec. 32, NE¼, Public domain.
Sec. 33. NW¼, Southern Pacific Land Co., Southern Pacific Bldg., San Francisco.

T. 42 N., R. 6 W.

Sec. 6, SE¼, Geo. A. Stockfleth, c/o Sullivan, Roche, Johnson & Berry, 220 Bush Street, San Francisco.
Sec. 6, Balance, public domain.
Sec. 7, NW¼, H. A. Craig, Gazelle.
Sec. 7, SW¼, Southern Pacific Land Co., Southern Pacific Bldg., San Francisco.
Sec. 18, NW¼, Robert M. Hamilton, Gazelle.

T. 42 N., R. 7 W.

Sec. 1, SE¼, Clarance McCoy, Gazelle.
NE¼, Southern Pacific Land Co., Southern Pacific Bldg., San Francisco.
Sec. 7, See under Mt. Shasta Lime Co. above.
Sec. 12, NW¼, Barney McCoy, Gazelle.
Sec. 12, See also under Mt. Shasta Lime Co. above.

T. 43 N., R. 8 W.

Sec. 35, SE¼, Southern Pacific Land Co., Southern Pacific Bldg., San Francisco.
Sec. 36, W½, Frank Sharp, Fort Jones.

T. 44 N., R. 7 W.

Sec. 4, N½, Clara Walter and William Murray, Yreka.

Deposits that have been listed in past reports follow:

Name of deposit and location	*Remarks*
Burton, Sec. 17, T. 43 N., R. 9 W., 4 mi. NE. of Greenview	limestone
Farrington, Sec. 24, T. 40 N., R. 9 W., 2½ mi. SW. of Callahan	limestone
Marble Mountain, Sec. 16, 19, 20, 21, T. 43 N., R. 10 W.	marble
Barton & Barham, Sec. 18, T. 46 N., R. 9 W., in Oak Bar district.	
Luce, two miles north of Fort Jones in Deadwood district	good marble
McDaniels, Sec. 6, T. 41 N., R. 9 W.	white marble
Parker, Sec. 32, T. 42 N., R. 9 W., near Etna Mills	pink, white marble
Thompson Creek, Sec. 8, T. 17 N., R. 8 E., H. M., 8½ mi. NE. of Happy Camp	white marble

Bibl: (Siskiyou County limestone) State Mineralogist's Reports XIII, p. 632; XIV, pp. 865, 867; XXI, p. 492; XVII, map Cal. State Mining Bur. Bull. 38.

MANGANESE

Manganese prospects have been reported from Sec. 9 or 16, T. 44 N., R. 8 W., southwest of Yreka; Sec. 15, T. 46 N., R. 6 W., six miles southwest of Klamathon; Secs. 20 and 21, T. 43 N., R. 9 W., on the ridge north of Greenview and southeast of Oro Fino; and in T. 39 N., R. 11 W., near the head of Callahan Gulch. For further particulars the reader is referred to California Division of Mines Bulletin 76, 'Manganese and Chromium,' published in 1918.

A manganese prospect was reported, about 1931, as being found in grading the new road from Black Bear to the King Solomon mine.

MINERAL WATER

There are in the county a number of mineral springs, several of which have been known for years as summer resorts. Considerable water has also been shipped from Shasta Springs. Among the principal resorts are Shasta Springs, Warmcastle Soda Springs, Klamath Hot Springs, Garretson Springs, Neys Springs and Upper Soda Spring. These, except Klamath Hot Springs, are cold carbonated springs. All of these springs have been described in the past publications of the Bureau and at a later date (1915) in U. S. Geological Survey Water Supply Paper 338, which covers the subject in great detail, so that there is no need of repeating this information here. Waring in the last mentioned report lists 15 groups of carbonated springs in the county. They may be grouped in three localities; those near Beaver Creek, in the northeastern part of the county, those in the western part of the lava-covered area in the vicinity of Ager, and a third and most important group because of their accessibility, near Sacramento River in the southern part of the county.

Bibl: Cal. State Min. Bur. R. XIII, p. 520; XI pp. 449, 452. U. S. G. S.; W. S. P. 338; Winslow Anderson, Mineral Springs of California.

MOLYBDENITE

Yellow Butte Mine. See under Copper.

ORNAMENTAL AND GEM STONES

Californite, a massive green vesuvianite, was first found on Indian Creek, north of Happy Camp. It is a hard, massive mineral with a vitreous luster and varies in color from nearly white to olive green. It has been mistaken for jade here and in other localities. The mineral occurs on claims belonging to the *Reeves Davis Estate* and *Henry Howard*, on the South Fork of Indian Creek, 10½ miles north of Happy Camp. It also is found as float, in large and small boulders, on placer claims belonging to *Scott Greening*, on O'Meara Creek, a tributary of Indian Creek, which enters it at the Classic Hill Mine, 12 miles north of Happy Camp, and pieces of float have been found elsewhere along the course of Indian Creek and in the mountains on the west side of the creek. Nothing has been done to develop it.

Bibl: Cal. State Min. Bur. Bull. 37, pp. 93, 94; R. XIV, p. 869.

Onyx occurs 200 yards downstream from Shasta Springs near Sacramento River. The deposit has been known as the *Griffin Onyx Marble Quarry* and contains a vein about five inches wide. Small articles such as paper weights have been made from it. Idle.

Fire opal is mentioned by Eakle * as occurring near Dunsmuir.

C. B. Kay of Ager has lately been doing some work on a deposit of fossiliferous sandstone which occurs on the *Henry Hagedorn* and *Sidney Richardson Ranches* five miles south of Ager in the NE¼ of Sec. 26, T. 46 N., R. 6 W. There are several beds of the stone, ranging from three inches to one foot wide and dipping east about 23°. Some of these beds are so thickly matted with shell remains as to give the polished stone a very pleasing and unique appearance as the sandstone is nearly black and in contrast with the white shells. The stone being fine-grained is hard and compact enough to take a polish, and might find a market for small articles. It contains a high percentage of cementing calcite in addition to that in the fossil shells.

PLATINUM GROUP METALS

Osmiridium and platinum occur with gold in the gravel deposits along Klamath River and Salmon River. The subject of the occurrence of these metals was covered by C. A. Logan in considerable detail in the Bureau's Bulletin 85. These metals occur in very small proportion to the gold content of the gravel, and the output from the county is negligible.

Field work for the above report showed that while platinum group metals occur in the gravel of the South Fork of Salmon River in appreciable amount from Matthews Creek downstream, at least as far as Forks of Salmon, there has been practically no platinum or osmiridium found in the placer mines of the North Fork, although these have yielded several times as much in gold as the placers of the South Fork. The presence of platinum group metals on the South Fork side, and their absence from the other fork, is attributed by the writer to the presence of considerable outcropping serpentine and peridotite in the drainage basin of the South Fork, while these rocks are found only in a few very small areas on the North Fork side. The platinum and osmiridium formerly recovered at the Nigger Hill and Michigan-Salmon hydraulic mines probably came from nearby serpentine areas. Nuggets up to ½ ounce in weight were found. An analysis of a shipment from the latter mine showed 97.05% osmiridium and 2.95% platinum. This comes nearer to being pure osmiridium than any other known sample in the state. While platinum usually occurs in the placers as thin, smoothly hammered flakes, similar in size and shape to fine placer gold, on account of its softness, osmiridium or iridosmine usually are found in ragged, angular pieces because of the great hardness of these native alloys. The latter may be dull, rusty, or coated, and might easily be mistaken for lead were it not for the fact that none of the metals of this group can be melted in an open fire as can lead, and the above named alloys are much harder than lead and as a rule so feebly magnetic (if at all so) that they are easily distinguished from iron or its compounds.

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* Eakle, A. S., Minerals of California: Cal. State Min. Bur. Bull. 91, 1923.

One ounce of platinum group metals to $3,000 in gold is about the usual proportion in this state where the two occur together. The proportion of platinum is a little higher than this on the South Fork of Salmon, and lower on the Klamath. None of the other placers of the county are known to have produced platinum, and none was recovered from the dredging operations on McAdams and Greenhorn creeks.

It is believed that the platinum metals in place occur only in narrow stringers or seams in serpentine and in the rocks from which serpentine is derived, such as peridotite, dunite and gabbro. Only one report has come to the writer's attention of platinum in place in this county. This was in a quartz stringer prospected by Morgan Bros. of Gottville, while hunting pockets on Empire Creek. They state that the report was made by a Denver assayer. The quartz prospect gave out entirely after being followed a few feet.

PUMICE

G. Z. Johnson, 255 California Street, San Francisco, produces pumice from Pumice Stone Mountain in T. 43 N., R 2 E., M. D. M., near Little Glass Mountain southwest of Mt. Hoffman.

Mt. Hoffman Pumice Claims comprise 960 acres, being all of Sec. 28 and the E½ Sec. 29, T. 44 N., R. 4 E. at Mt. Hoffman, in eastern Siskiyou County. These placer claims are held by E. L. Jameson, c/o S. C. Pennell, Tennant, California, Dan A. Williams, 418 California St., Salinas, California, and J. O. Miller. The property is 35 miles by road east of Tennant. A road has been built for this entire distance, but at time of visit (October, 1935) the last three miles could not be used because parts of the road had been destroyed by extensive logging operations.

Small pieces of pumice of the size of a marble and smaller are abundant in the soil for many square miles in this vicinity. Apparently much of this deposit is superficial, being only a foot or two deep. On the Mt. Hoffman claims, which are high on the mountain at an elevation of 7000 ft., the pumice is free from soil in many places, the lumps are larger, and the depth is greater. Here the larger lumps are several feet in diameter, and it is possible to saw bricks from them. The best pumice occurs on a little ridge, roughly half a mile long, 200 ft. high, and several hundred feet wide. One end of this ridge is capped by a flow of obsidian; but the larger part of it is free of this capping, and the surface is composed entirely of pumice. Tunnels have been driven into the pumice for 30 ft. exposing a mixture of lumps of various sizes, most of them small, but some of them 3 ft. to 4 ft. in diameter. One tunnel is said to have been driven for a distance of 125 ft. in pumice, but no tunnel of this length was open to inspection at time of visit.

A few tons of pumice have recently been shipped by truck for sawing into scouring-bricks, and for crushing to small sizes for use in acoustic plaster. A standard-gage logging railroad of the Long-Bel. Lumber Sales Corporation runs to a point about three quarters of a mile from the pumice deposit.

QUICKSILVER

Cowgill Quicksilver Mine. Owner, Mrs. A. M. Cowgill, P. O. Box 96, Yreka. In Sec. 34, T. 48 N., R. 9 W., on the headwaters of the West Fork of Beaver Creek, 10 miles in an air line from Gottville but farther by road.

According to Bradley * there was some work done here years ago by Siskiyou Quicksilver Mining Company, who built a 10-ton furnace and are said to have produced a few flasks of mercury. During the wartime boom in quicksilver, Mercury Company of America did some prospecting on the surface, and put up a 12-pipe retort. Cinnabar was found in the decomposed surface soil to a depth of 60 feet. This company did little work.

Horse Creek Cinnabar Co., Ltd. The following is quoted from State Mineralogist's Report XXVII, chapter for January, 1931:

> "This company is purchasing from H. J. Barton of Yreka 35 acres of patented mining claims in Sec. 15, 16, T. 46 N., R. 10 W., on Klamath River road where the Horse Creek bridge crosses the Klamath. The president is Dr. A. H. Taylor, 5558 Hollywood Boulevard, Los Angeles, and the secretary is Ben Cohn, Horse Creek, Siskiyou Co., California. Mica schist alternates with bands of hornblende schist, the schistosity on the latter not being so well developed as on the former. Small amounts of cinabar are seen on fractures in the dark-green hornblende schist; and it seems to be associated with this rock only. A mass of light-colored dioritic rock on the property also shows some schistosity. Development consists of three tunnels, 20 ft. to 30 ft. long and numerous (25 to 30) small prospect cuts on the hillside. These average 5 ft. long, 1 ft. wide and 4 ft. deep. The property was equipped with a continuous process retort with a rated capacity of 25 tons per day, which has not yet been successfully operated, because some of the metal parts failed to withstand the heat when it was first fired up. A 25-hp. Fairbanks-Morse gasoline engine furnished the power."

This property has been idle for some time.

Great Northern Quicksilver Mine, Inc. (present name from records of County Assessor) was described in State Mineralogist's XXVII, chapter for January, 1931, as follows:

> "*Mercury Mine* (No. 39 on map), formerly the *J. N. P. Mining Co.*, or *Morgan Brothers Mine*, is the property of Eugene Aureguy, Room 333 Mills Bldg., San Francisco. The location is Sec. 13, 14, 24, T. 47 N., R. 8 W., near Gottville or 21 miles from Hornbrook. The first 16 miles are improved highway along Klamath River; and 5 miles are unimproved mountain road. A total of 250 acres are held, also a water right in Sec. 18, T. 47 N., R. 7 W. A fissure vein striking S. 70° W., and dipping 55° to the northwest carries cinnabar and native mercury in a gangue of quartz and calcite. Country rock is schist formed from metamorphosed sediments intruded by granodiorite; and the ore seems to be associated with the contact between these two rocks. However, faulting is in evidence; and the possibility exists that the mineralization has come up along this from younger intrusive rocks below. Less than 10 miles to the east, Tertiary volcanic rocks are exposed on the surface. A stope, 100 ft. long, was being made on the vein mentioned above, with a width of 5½ ft. average, 12 ft. maximum and a height of 20 ft. above the main level. A raise of 140 feet on the vein connects the top of this stope with the surface. This main level is an adit, from which several hundred feet of work, drifts and crosscuts, have been done. A second adit, from which several hundred feet of work have been done, is about 50 feet above and 500 ft. to the east of the main adit. Some ore is exposed here also.
>
> The property is equipped with a flotation plant of a capacity of 24 tons per 24 hours. A crusher, 10 by 12 in., reduces the ore to one-inch size; and this is fed to a 15-ton (rated capacity) ball mill by an automatic feeder, and is here reduced to 40-mesh. This product is treated in three Kraut flotation machines; and concentrates are retorted in Hendy pipe retorts, six pipes, 12 inches by 6 feet, with oil as fuel. An attempt is made to recover native mercury at the discharge of the ball mill on copper plates. A 75-hp. Holt gasoline engine runs the plant. Mine equipment includes a compressor of one-drill capacity, rails and cars. W. W. Young of Gottville is superintendent; and six men are employed.
>
> Bibl: State Mineralogist's Report XXI, p. 496; Bull. 78, p. 169."

In 1935, C. J. Moore, M. J. Orth and F. A. Riggs of Klamath River (postoffice), were leasing the property and were experimenting with a furnace of their own design. It has a circular rotating hearth, 4 ft. in diameter; and the capacity is stated to be 10 tons in 24 hours. At time of visit changes had just been made in the condensing system, and the furnace had not yet been operated with the new condenser of tile pipe, three feet in diameter. These lessees had done no new work in the mine.

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* Bradley, W. W., Quickslіver Resources of California: Cal. State Min. Bur. Bull. 78, p. 169, 1918.

SANDSTONE

Sandstone beds form the rim of Shasta Valley, outcrop east of Yreka and are found at several places from Snowdon to the Oregon line (see under Geology). A number of years ago, before cement came into such general use, sandstone was quarried here as well as in other counties of the state. Three quarries were described in our past reports.

Antone or *Weeks Quarry* is two miles northeast of Yreka. The sandstone was quarried in layers from six inches to eight feet thick and has been used considerably for building in Yreka.

Fiock Bros. Quarry is in Sec. 13, T. 45 N., R. 7 W., near Yreka. The stone is coarse grained, even textured and tawny in color.

Southern Pacific Company has quarried considerable sandstone in Sec. 29, T. 47 N., R. 6 W., near Hornbrook. This stone has been used for railroad culverts and for some buildings in Hornbrook.

SOAPSTONE

Soapstone and talc might reasonably be expected to occur at many places in the county, where serpentine is found. For the location of serpentine outcrops, the reader should refer to the sections on Asbestos and Chromite, herein. To date, no commercial development of soapstone has taken place in Siskiyou County. For the most part, the deposits noted are a considerable distance from the railroad. Such deposits, of good size and said to be of satisfactory quality, are found in the northeast part of T. 45 N., R. 11 W., southeast of Hamburg Bar; also near the head of Wooley Creek, and better grades are said to have been found in a deposit on top of the divide between Beaver and Bumblebee Creeks and in a small deposit in Sec. 32, T. 42 N., R. 9 W., near Etna Mills. The business of soapstone and talc production and marketing is highly competitive, and the market prices of lower grade and 'off color' soapstone and talc are so low that only deposits near the railroad can be worked at a profit. There is a scarcity of high-grade, white-grinding talc, however, in the northern end of the state, such ore at present coming from the southern counties, while 'off color' soapstone, used for roofing where the shade is not important, is produced near the railroad in El Dorado County.

STONE INDUSTRY

Since 1916, Siskiyou County has produced considerable crushed rock and gravel for road construction. The stream gravels near Yreka, as for example the dredged portions of Greenhorn Creek, and some areas of volcanic rock near enough the railroad are the most convenient sources of supply. There has been a considerable length of both state highway and rock-surfaced county roads built in Siskiyou

County during recent years, and local stone has been utilized. Part of it was crushed dredger tailing from a point a mile south of Yreka. Buildings of lavas and tuffs may be seen at Mt. Shasta City and Weed. The rocks are crystalline; and the different natural colors and shades, when used together, give very pleasing effects.

SACRAMENTO FIELD DISTRICT

C. A. Logan, Mining Engineer

Mr. C. A. Logan, district engineer, is engaged in investigation for a new report upon the gold mines of Placer County.

SAN FRANCISCO FIELD DISTRICT

C. McK. Laizure, Mining Engineer

Reports covering the mines and mineral resources of all of the counties in the San Francisco field division are now available, and field work at present is confined to investigations for special reports upon various economic minerals.

LOS ANGELES FIELD DISTRICT

W. B. Tucker and R. J. Sampson, Mining Engineers

Reports covering the mines and mineral resources of most of the counties in the Los Angeles field division are now available, and field work at present is confined to investigations for special reports upon various economic minerals.

GEOLOGIC BRANCH

CURRENT NOTES

Olaf P. Jenkins, Chief Geologist

Since the publication of Bulletin 104, "*Bibliography of the Geology and Mineral Resources of California to December 31, 1930,*" a large number of new articles on these subjects have appeared. These new publications have all been listed for the years 1931 to 1934, inclusive, by Dr. Solon Shedd, author of Bulletin 104. Thus a supplementary bibliography is now ready for the press.

There has been such a constant demand for Bulletin 91, "*Minerals of California,*" by the late Dr. Arthur S. Eakle, that the stock has become exhausted. Since there is now available a large amount of new information on the minerals of the state, their geological occurrence as well as their location, it seems advisable to revise this book before republishing it. In order to do a thorough job of compiling this new information, the Division of Mines wishes to enlist all interested mineralogists, geologists, and mineral collectors in the effort of assembling data. Contributions will be received with grateful appreciation. Already several persons have sent to us lists of corrections and additions which will be properly compiled and included in the new book.

OIL FIELD DEVELOPMENT OPERATIONS

R. D. Bush, State Oil and Gas Supervisor

From March 31, 1935, to and including June 29, 1935, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
COLUSA COUNTY:					
Birch Ranch & Oil Co. and Irwin S. Burgess	25	15 N.	4 W.	Stovall-Wilcoxson 1	
FRESNO COUNTY:					
W. W. Bush and I. M. Bush	6	21 S.	15 E.	5	Coalinga
Shoreline Oil Corp.	17	19 S.	15 E.	20	Coalinga
Standard Oil Co.	13	20 S.	14 E.	37	Coalinga
Tyler, Cederquist & King	14	20 S.	14 E.	2	Coalinga
John F. Wilcox	11	20 S.	14 E.	3	Coalinga
Kettleman North Dome Assoc.	24	21 S.	16 E.	54	Kettleman North Dome
Kettleman North Dome Assoc.	18	21 S.	17 E.	8	Kettleman North Dome
Kettleman North Dome Assoc.	18	21 S.	17 E.	47	Kettleman North Dome
Kettleman North Dome Assoc.	28	21 S.	17 E.	23	Kettleman North Dome
Kettleman North Dome Assoc.	28	21 S.	17 E.	34	Kettleman North Dome
Kettleman North Dome Assoc.	30	21 S.	17 E.	41	Kettleman North Dome
Kettleman North Dome Assoc.	32	21 S.	17 E.	63	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	23	Kettleman North Dome
Taft Well Drilling Co.	33	22 S.	16 E.	1	
IMPERIAL COUNTY:					
J. P. Chandler & Lee Staton	19	11 S.	14 E.	1	
KERN COUNTY:					
Belridge Oil Co.	35	27 S.	20 E.	28-35	Belridge
Union Oil Co.	36	27 S.	20 E.	Belridge 19	Belridge
Union Oil Co.	36	27 S.	20 E.	Gibson 7	Belridge
Fullerton Oil Co.	25	27 S.	23 E.	32	Buttonwillow Gas
Fullerton Oil Co.	26	27 S.	23 E.	72	Buttonwillow Gas
Amerada Petroleum Corp.	17	26 S.	19 E.	3	Devils Den
Berry Oil Co.	10	30 S.	29 E.	Grayson 1	Edison
Ralph W. Ellithorpe	18	30 S.	30 E.	Claire 1	Edison
General Petroleum Corp.	24	30 S.	29 E.	Knapp 2	Edison
R. E. Hutcheson & H. E. Osborne	32	30 S.	30 E.	O & H 1	Edison
A. T. Jergins Trust	13	30 S.	29 E.	McCowan 13-A 4	Edison
A. T. Jergins Trust	14	30 S.	29 E.	Hershey 1-A	Edison
A. T. Jergins Trust	24	30 S.	29 E.	Smithwich 2	Edison
Shell Oil Co.	14	30 S.	29 E.	Clare 1	Edison
Shell Oil Co.	14	30 S.	29 E.	Nichols 4	Edison
Western Gulf Oil Co.	21	29 S.	27 E.	Edward West 1	Fruitvale
Western Gulf Oil Co.	21	29 S.	27 E.	Holterman 1	Fruitvale
Western Gulf Oil Co.	21	29 S.	27 E.	Scott 1	Fruitvale
Western Gulf Oil Co.	27	29 S.	27 E.	Parker 2	Fruitvale
Western Gulf Oil Co.	27	29 S.	27 E.	Red Ribbon Ranch 1	Fruitvale
Associated Oil Co.	23	28 S.	27 E.	32	Kern River
Bishop Oil Co.	26	28 S.	27 E.	McDonald 7	Kern River
C. C. M. O. Co.	23	28 S.	27 E.	42	Kern River
C. C. M. O. Co.	23	28 S.	27 E.	43	Kern River
C. C. M. O. Co.	23	28 S.	27 E.	44	Kern River
Deep Zone Oil Co.	29	28 S.	27 E.	1	Kern River
George F. Getty, Inc.	26	28 S.	27 E.	Grady 2	Kern River
George F. Getty, Inc.	26	28 S.	27 E.	Grady 4	Kern River
George F. Getty, Inc.	26	28 S.	27 E.	Grady 9	Kern River
The Kern River Oilfields of Calif., Ltd.	25	28 S.	27 E.	2	Kern River
The Kern River Oilfields of Calif., Ltd.	25	28 S.	27 E.	3	Kern River
The Kern River Oilfields of Calif., Ltd.	25	28 S.	27 E.	4	Kern River
Republic Petroleum Co., Ltd.	24	28 S.	27 E.	Strassburger 1	Kern River
Republic Petroleum Co., Ltd.	24	28 S.	27 E.	Strassburger 2	Kern River
Belmac Drilling Co.	22	29 S.	21 E.	Douglas 1	McKittrick
Welport Oil Co.	26	29 S.	21 E.	11	McKittrick
C. C. M. O. Co.	21	32 S.	23 E.	17	Midway
Honolulu Oil Corp., Ltd.	14	32 S.	24 E.	3-A	Midway
Honolulu Oil Corp., Ltd.	14	32 S.	24 E.	44	Midway
Honolulu Oil Corp., Ltd.	14	32 S.	24 E.	45	Midway
Honolulu Oil Corp., Ltd.	14	32 S.	24 E.	53	Midway
North American Oil Consolidated	2	32 S.	24 E.	1	Midway
Pan American Petroleum Co.	22	32 S.	23 E.	Buena Fe 64	Midway
Pan American Petroleum Co.	22	32 S.	23 E.	Buena Fe 65	Midway
Standard Oil Co.	13	32 S.	24 E.	5	Midway
Standard Oil Co.	15	32 S.	24 E.	119	Midway
Baker-Grover Co.	33	27 S.	28 E.	Baker 1	Mt. Poso
California-Kern Oil Co.	33	26 S.	28 E.	S. P. 1	Mt. Poso
Federal Petroleum Co.	28	26 S.	28 E.	Dominion 5	Mt. Poso
Himovitz Lease Co.	21	27 S.	28 E.	4	Mt. Poso

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued					
Modoc Petroleum, Limited	28	26 S.	28 E.	Vedder 3	Mt. Poso
Section Two Oil Co	2	27 S.	28 E.	1	Mt. Poso
Shell Oil Co.	4	27 S.	28 E.	Matthew Fee 3	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 20	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 21	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 22	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 23	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 24	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 25	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder-Rall 9	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder-Rall 10	Mt. Poso
Shell Oil Co.	16	27 S.	28 E.	Security 14	Mt. Poso
Stevens Oil Corp.	7	27 S.	28 E.	Mt. Poso 1	Mt. Poso
The Texas Co.	15	27 S.	28 E.	Glide 2 5	Mt. Poso
Barnsdall Oil Co.	32	30 S.	29 E.	Morris 4	Mountain View
C. C. M. O. Co.	11	30 S.	28 E.	McKendree College 1	Mountain View
General Petroleum Corp.	14	30 S.	28 E.	Brantley 5	Mountain View
The Hancock Oil Co.	14	30 S.	28 E.	Miller 7	Mountain View
Mohawk Petroleum Co.	30	30 S.	29 E.	Clendenen 4	Mountain View
Mohawk Petroleum Co.	30	30 S.	29 E.	Clendenen 5	Mountain View
Mohawk Petroleum Co.	30	30 S.	29 E.	Hood 6	Mountain View
The Ohio Oil Co.	33	30 S.	29 E.	Derby 2	Mountain View
Soverign Oil Corp.	30	30 S.	29 E.	San Joaquin 4	Mountain View
Standard Oil Co.	13	30 S.	28 E.	Abadie 1	Mountain View
Standard Oil Co.	23	30 S.	28 E.	Wible 6	Mountain View
Standard Oil Co.	24	30 S.	28 E.	Ranton 5	Mountain View
The Texas Co.	14	30 S.	28 E.	Mateo Smith 2	Mountain View
Associated Oil Co.	4	28 S.	27 E.	1	Poso Creek
Associated Oil Co.	4	28 S.	27 E.	2	Poso Creek
The Ohio Oil Co.	22	27 S.	27 E.	Brown 2	Poso Creek
The Ohio Oil Co.	32	27 S.	27 E.	Midway Premier 5	Poso Creek
Gus Pongratz	2	27 S.	27 E.	Dorsey 1-A	Poso Creek
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	16	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	23	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	35	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	46	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	47	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	62	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	63	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	66	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	78	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	93	Round Mountain
Honolulu Oil Corp., Ltd.	20	28 S.	29 E.	A	Round Mountain
Hallmark Oil Co., Inc.	25	12 N.	24 W.	2	Sunset
Michigan Oil Co.	6	11 N.	23 W.	1	Sunset
Standard Oil Co.	26	12 N.	24 W.	Monarch 17	Sunset
E. A. Bender	2	29 S.	20 E.	Hall-Baker 1	Temblor
Fullerton Oil Co.	1	27 S.	22 E.	76	
Fullerton Oil Co.	9	27 S.	23 E.	27	
Fullerton Oil Co.	14	27 S.	23 E.	27	
Milham Exploration Co.	15	27 S.	23 E.	Continental 22–15	
Milham Exploration Co.	15	27 S.	23 E.	Continental 63–15	
Reserve Oil and Gas Co.	12	10 N.	19 W.	Tejon Ranch 3	
Silver Gate Co.	7	10 N.	19 W.	1	
Standard Oil Co.	12	25 S.	23 E.	Widgeon 2	
Standard Oil Co.	12	27 S.	23 E.	Hornung 1	
Standard Oil Co.	5	27 S.	23 E.	Goldman 1	
Standard Oil Co.	7	27 S.	23 E.	Towle Estate 1	
Standard Oil Co.	9	27 S.	23 E.	Henry & Chapman 1	
Standard Oil Co.	9	27 S.	23 E.	Smith Fee 1	
George Sunday, Jr.	5	30 S.	30 E.	1	
Superior Oil Co.	23	27 S.	23 E.	Bradford 1	
Trico Oil and Gas Co.	3	25 S.	23 E.	5	
Woodward Oil Co., Ltd.	36	29 S.	29 E.	Wirth 1	
Woodward Oil Co., Ltd.	31	29 S.	30 E.	S. P. 2	
KINGS COUNTY:					
Petroleum Securities Co.	30	23 S.	19 E.	73	Kettleman Middle Dome
Kettleman North Dome Assoc.	26	22 S.	18 E.	54	Kettleman North Dome
Standard Oil Co.	35	21 S.	17 E.	34	Kettleman North Dome
Dudley Ridge Development Co.	24	23 S.	20 E.	Josephine 1	
Reef Ridge Producers	11	23 S.	16 E.	Baby King 3	
LOS ANGELES COUNTY:					
Shell Oil Co.	33	3 S.	13 W.	Reyes 72	Dominguez
Shell Oil Co.	33	3 S.	13 W.	Reyes 73	Dominguez
Shell Oil Co.	33	3 S.	13 W.	Reyes 75	Dominguez
Shell Oil Co.	33	3 S.	13 W.	Reyes 76	Dominguez

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Continued					
Shell Oil Co.	34	3 S.	13 W.	Reyes 66	Dominguez
Shell Oil Co.	34	3 S.	13 W.	Reyes 78	Dominguez
Shell Oil Co.	34	3 S.	13 W.	Reyes 79	Dominguez
Union Oil Co.	33	3 S.	13 W.	Carson 7	Dominguez
Associated Oil Co.	7	2 S.	14 W.	Vickers 53	Inglewood
Shell Oil Co.	8	2 S.	14 W.	Rindge 18	Inglewood
Shell Oil Co.	8	2 S.	14 W.	Rindge 19	Inglewood
Standard Oil Co.	8	2 S.	14 W.	L. A. Investment Lease 74	Inglewood
Standard Oil Co.	8	2 S.	14 W.	L. A. Investment Lease 75	Inglewood
Standard Oil Co.	8	2 S.	14 W.	Vickers 1 32	Inglewood
Affiliated Oil Producers, Inc.	30	4 S.	12 W.	Randall 1	Long Beach
Affiliated Petroleum Corp.	20	4 S.	12 W.	1	Long Beach
The Beck Oil Co.	29	4 S.	12 W.	Beck 1	Long Beach
Besco Oil, Inc.	20	4 S.	12 W.	1	Long Beach
Beverly Oil Co.	29	4 S.	12 W.	Benson 1	Long Beach
R. R. Bush Oil Co.	29	4 S.	12 W.	H. & W. 2	Long Beach
C. B. Oil Co.	24	4 S.	13 W.	2	Long Beach
Capitol Development Co.	30	4 S.	12 W.	Taylor 2	Long Beach
Century Oil Co.	30	4 S.	12 W.	1	Long Beach
Chief Oil Co.	29	4 S.	12 W.	Chief 3	Long Beach
Christi Corp.	30	4 S.	12 W.	C. C. 1	Long Beach
Coastal Oil Co.	30	4 S.	12 W.	Coastal 1	Long Beach
Coastal States Oil Co.	20	4 S.	12 W.	Coastal 2	Long Beach
Delta Petroleum Corp.	29	4 S.	12 W.	Delta 1	Long Beach
W. O. Dye	19	4 S.	12 W.	Dye 4	Long Beach
Eastside Oil Co.	30	4 S.	12 W.	Eastside-Poetevin 1	Long Beach
Elmore Oil Co.	29	4 S.	12 W.	Hinshaw 2	Long Beach
Fairway Oil Co.	19	4 S.	12 W.	Fairway 1	Long Beach
Good-Rich Drilling Co.	28	4 S.	12 W.	1	Long Beach
Great Western Petroleum Corp.	29	4 S.	12 W.	2	Long Beach
Harlyn Oil Co.	29	4 S.	12 W.	Painted Hills 2	Long Beach
Hillman Oil Co.	30	4 S.	12 W.	Hillman 1	Long Beach
Hiwa Petroleum Corp.	29	4 S.	12 W.	Flower State 1	Long Beach
Jackson & Jackson	30	4 S.	12 W.	Jackson Bros. 1	Long Beach
Jahns Oil Co.	24	4 S.	13 W.	Bowles 1	Long Beach
Jose Oil Co., Ltd.	30	4 S.	12 W.	Jose 2	Long Beach
Kiowa Petroleum Corp.	30	4 S.	12 W.	Kiowa 3	Long Beach
La Rita Oil Co.	30	4 S.	12 W.	1	Long Beach
Legion Oil Co.	30	4 S.	12 W.	1	Long Beach
Lion Petroleum Corp.	30	4 S.	12 W.	1	Long Beach
M. K. & T. Leasing Co.	29	4 S.	12 W.	M. K. & T. 1	Long Beach
M. & M. Oil Co.	30	4 S.	12 W.	M. & M. 1	Long Beach
Magnolia Petroleum Corp.	19	4 S.	12 W.	Mum 2	Long Beach
Mines Oil Co.	19	4 S.	12 W.	3	Long Beach
Alfred D. Mitchell	19	4 S.	12 W.	7	Long Beach
Mullins Oil, Inc.	30	4 S.	12 W.	1	Long Beach
Nedal Oil Co.	19	4 S.	12 W.	3	Long Beach
Omeco Oil Co.	30	4 S.	12 W.	Omeco 1	Long Beach
Orbit Oil Co.	29	4 S.	12 W.	Orbit 1	Long Beach
Sea View Oil Co.	19	4 S.	12 W.	1	L9ng Beach
Sentinel Oil Co.	30	4 S.	12 W.	Sentinel 3	Long Beach
Shelton Oil Co.	29	4 S.	12 W.	Shelton 1	Long Beach
Signal-Belle Oil Co.	30	4 S.	12 W.	Signal-Belle 1	Long Beach
Silver Bullion Co.	20	4 S.	12 W.	Dodge 1	L9ng Beach
Southern State Oil Co.	29	4 S.	12 W.	Feldman 1	Long Beach
Neil H. Stewart	24	4 S.	13 W.	Stewart Petroleum 1	Long Beach
G. L. Taylor	30	4 S.	12 W.	Taylor 1	Long Beach
Twentieth Century Oil Corp., Inc.	29	4 S.	12 W.	Painted Hills 1	Long Beach
Utah Development Co.	29	4 S.	12 W.	Painted Hills 1	Long Beach
Warrior Petroleum Corp.	30	4 S.	12 W.	1	Long Beach
Western Development Corp.	29	4 S.	12 W.	Western Development 1	Long Beach
Winslow Oil Co.	19	4 S.	12 W.	Winslow 1	Long Beach
World Oil Co.	30	4 S.	12 W.	1	Long Beach
The Texas Co.	5	2 S.	11 W.	City of Whittier 1	Montebello
Universal Consolidated Oil Co.	5	2 S.	11 W.	E 1	Montebello
Universal Consolidated Oil Co.	5	2 S.	11 W.	F 1	Montebello
Wilshire Oil Co.	5	2 S.	11 W.	Montebello 1	Montebello
Allied Petroleum Corp.	27	2 S.	15 W.	Allied 17	Playa del Rey
Big Ben Oil Co.	27	2 S.	15 W.	Ben 2	Playa del Rey
Birch-Royer Oil Co.	34	2 S.	15 W.	Hisey-Thrall 1	Playa del Rey
Black Line Oil Co.	27	2 S.	15 W.	1	Playa del Rey
G. G. Champ	26	2 S.	15 W.	Champ 1	Playa del Rey
Colly Oil Co.	27	2 S.	15 W.	Colly 2	Playa del Rey
Crest Oil Co.	27	2 S.	15 W.	Crest 1	Playa del Rey

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Continued					
Dabney Petroleum Corp.	27	2 S.	15 W.	Pamaco 2	Playa del Rey
Dabney Petroleum Corp.	27	2 S.	15 W.	Pamaco 3	Playa del Rey
Del Rey Realty Co.	27	2 S.	15 W.	Herndon Development 29	Playa del Rey
Dunlap Petroleum Co.	27	2 S.	15 W.	2	Playa del Rey
Embee Oil Co.	27	2 S.	15 W.	Embee 1	Playa del Rey
Otis Hoyt Co.	34	2 S.	15 W.	Del Rey 1	Playa del Rey
Joyce Oil Co.	27	2 S.	15 W.	Joyce 1	Playa del Rey
Thomas Kelly & Lawrence C. Kelly	27	2 S.	15 W.	T. & L. 1	Playa del Rey
Andrew Lucas	35	2 S.	15 W.	Inglewood Extension 1	Playa del Rey
Lugra Oil Co.	27	2 S.	15 W.	Lugra 1	Playa del Rey
Mathews Petroleum Corp.	34	2 S.	15 W.	Mathews 2	Playa del Rey
Ed McAdams	27	2 S.	15 W.	Del Rey 2	Playa del Rey
The Ohio Oil Co.	28	2 S.	15 W.	Recreation Gun Club 17	Playa del Rey
Red Seal Oil Co., Ltd.	27	2 S.	15 W.	Ben 3	Playa del Rey
Royalty Service Corp., Ltd.	27	2 S.	15 W.	Del Rey 2	Playa del Rey
Royalty Service Corp., Ltd.	27	2 S.	15 W.	Del Rey 12–1	Playa del Rey
Royalty Service Corp., Ltd.	27	2 S.	15 W.	Del Rey 13–1	Playa del Rey
Royalty Service Corp., Ltd.	27	2 S.	15 W.	Del Rey 23–1	Playa del Rey
Trans-Western Petroleum Corp.	27	2 S.	15 W.	1	Playa del Rey
Union Oil Co.	27	2 S.	15 W.	Del Rey 9	Playa del Rey
Union Oil Co.	27	2 S.	15 W.	King Vidor 10	Playa del Rey
Union Oil Co.	27	2 S.	15 W.	King Vidor 11	Playa del Rey
Union Oil Co.	27	2 S.	15 W.	King Vidor 12	Playa del Rey
Union Oil Co.	28	2 S.	15 W.	Del Rey 10	Playa del Rey
Williams & Harper	27	2 S.	15 W.	Williams-Harper 1	Playa del Rey
Winoco Producing and RefiningCo., Ltd.	26	2 S.	15 W.	1	Playa del Rey
General Petroleum Corp.	5	3 S.	11 W.	Santa Fe 44	Playa del Rey
Union Oil Co.	31	2 S.	11 W.	Bell 81	Playa del Rey
Union Oil Co.	31	2 S.	11 W.	Bell 82	Playa del Rey
Union Oil Co.	31	2 S.	11 W.	Bell 84	Playa del Rey
Union Oil Co.	31	2 S.	11 W.	Bell 86	Playa del Rey
Standard Oil Co.	3	5 S.	12 W.	San Gabriel 26	Seal Beach
C. C. M. O. Co.	8	4 S.	14 W.	Redondo 2	Torrance
Monarch Oil Corp.	5	1 S.	16 W.	Sylvia Park 1	----------
West America Oil Co.	17	2 S.	12 W.	Bandini 1	----------
Western Gulf Oil Co.	16	2 S.	12 W.	Vail 1	----------
Woodworth Oil Co., Ltd.	4	2 S.	11 W.	Lapworth 1	----------
ORANGE COUNTY:					
C. C. M. O. Co.	9	3 S.	9 W.	99	Brea-Olinda
General Petroleum Corp.	6	3 S.	9 W.	Tonner 16	Brea-Olinda
Standard Oil Co.	18	3 S.	10 W.	Murphy-Coyote 123	Coyote Hills
Standard Oil Co.	19	3 S.	10 W.	Murphy-Coyote 124	Coyote Hills
Andel Oil Co.	11	6 S.	11 W.	1	Huntington Beach
Associated Oil Co.	34	5 S.	11 W.	Fowler 8	Huntington Beach
Associated Oil Co.	34	5 S.	11 W.	Pearce 7	Huntington Beach
Doran & Baker, Inc.	2	6 S.	11 W.	Thompson 1	Huntington Beach
Lucky Strike Oil Co., Ltd.	35	5 S.	11 W.	Lucky Strike 4	Huntington Beach
Standard Oil Co.	4	6 S.	11 W.	Huntington B 73	Huntington Beach
Steveco Petroleum	35	5 S.	11 W.	Adele 2	Huntington Beach
Wilshire Oil Co., Inc.	28	6 S.	10 W.	Newport 1	Huntington Beach
Viking Oil Co.	29	3 S.	9 W.	Wagner 1	Richfield
Domain Development Corp.	3	6 S.	7 W.	Trabuco 1	----------
SANTA BARBARA COUNTY:					
General Petroleum Corp.	32	5 N.	30 W.	Erburu 15	Capitan
Shell Oil Co.	32	5 N.	30 W.	Covarrubias 1 8	Capitan
Honolulu Oil Corp., Ltd.	15	4 N.	29 W.	90–9	Elwood
Pacific Western Oil Co.	16	4 N.	29 W.	92–15	Elwood
Caroline C. Spaulding	16	4 N.	29 W.	Blue Goose 93 10	Elwood
Shell Oil Co.	10	4 N.	29 W.	Hollister 1	Goleta
Anacapa Oil Corp.	28	4 N.	27 W.	Low 3	Mesa
M. & L. Oil Co.	28	4 N.	27 W.	Consolidated 1	Mesa
M. & L. Oil Co.	29	4 N.	27 W.	M. & L. 2	Mesa
Union Oil Co.	26	9 N.	34 W.	California Coast 15	Santa Maria
M. J. Freeman	11	7 N.	33W.	La Brea 1	----------
TULARE COUNTY:					
Kabella Oil Co.	12	23 S.	27 E.	H. A. Briggs 1	----------
Kings River Oil Pool	29	16 S.	23 E.	1	----------
Standard Oil Co.	34	24 S.	23 E.	Rideout 1	----------

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
VENTURA COUNTY:					
Union Oil Co.	12	3 N.	20 W.	Dryden 1	Bardsdale
Rennie Brothers	21	4 N.	21 W.	1	Santa Paula
Bankline Oil Co.	36	5 N.	20 W.	1	Sespe
H. A. Ivers	1	4 N.	20 W.	12	Sespe
Charles and Hoxie Anderson	36	3 N.	18 W.	Marr 14	Simi
E. F. Stella	6	2 N.	17 W.	Button 1-A	Simi
Calco Petroleum Corp.	17	3 N.	20 W.	Schieferle 2	South Mountain
Associated Oil Co.	23	3 N.	23 W.	Lloyd 105	Ventura
Associated Oil Co.	23	3 N.	23 W.	McGonigle 8	Ventura
Associated Oil Co.	26	3 N.	23 W.	Lloyd 136	Ventura
Associated Oil Co.	27	3 N.	23 W.	Lloyd 49	Ventura
Brown and Thomas	33	4 N.	23 W.	26	Ventura
Shell Oil Co.	29	3 N.	23 W.	Taylor 69	Ventura
General Petroleum Corp.	26	2 N.	23 W.	McGrath 1	----------

SPECIAL ARTICLES

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of the new laws and official regulations and notices affecting the mineral industry.

DAMS FOR HYDRAULIC MINING DEBRIS

By WALTER W. BRADLEY, State Mineralogist

Mining by hydraulic process of the important gold-bearing gravels of the Sacramento Valley in the basins of the Yuba, Bear, and American rivers began in 1853, and continued at an ever-increasing rate for 30 years. During that period no provisions were made to prevent the debris from these operations being discharged into the watercourses, and as a result large quantities of silt, sand, and gravel ultimately were washed down to the lower valleys, filling channels, causing overflow of agricultural lands and difficulty in maintaining navigable depths in Sacramento River.

Agitation and suits filed because of these damages finally resulted in the injunction decision of Judge L. B. Sawyer in the U. S. Circuit Court in 1884, which closed down practically all hydraulic mining operations not having means of restraining their debris. In 1893, Congress passed the act introduced by Representative Anthony Caminetti of California, creating the California Debris Commission, composed of three officers assigned from the Engineer Corps of the U. S. Army. Since which time, it has been legal and possible within the drainage systems of Sacramento and San Joaquin rivers to conduct hydraulic mining of gold-bearing gravels behind dams built under this commission's permit and supervision. It should be noted, here, that such permits are not required in the watersheds of Trinity and Klamath rivers which flow direct to the Pacific Ocean and do not affect navigation nor agriculture.

In Sec. 23 of the Caminetti Act, authorization was given, and it was assumed that provision of funds would be made from time to time, for construction of debris dams by the commission, the cost of which would be repaid by storage charges by those mines operating above such dams. Thus far, however, in all of the 42 years since the enactment of the Caminetti Act no appropriation has been made for the building of such debris dams. Due largely to the difficulty and cost of providing the required storage works, except by a few scattered mines, operations have been greatly restricted. At the 1934 session of Congress, Representative Harry L. Englebright of California introduced and succeeded in having passed an amendment (approved June 19, 1934) to the

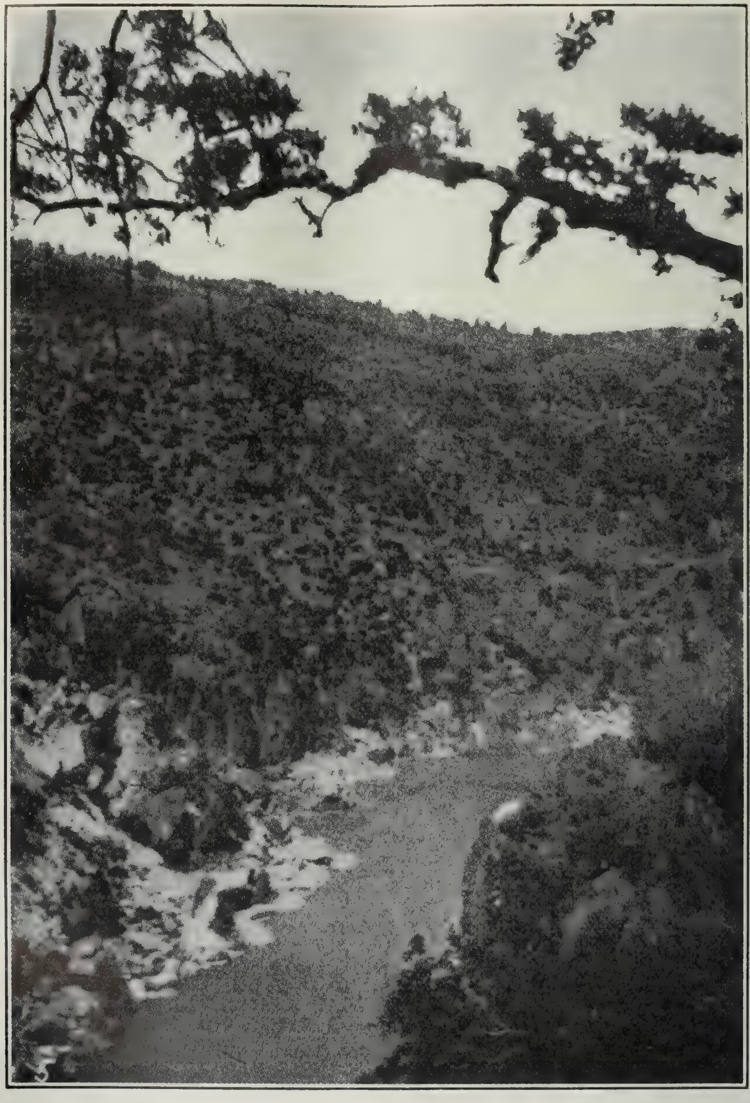

Photo by Arthur Jarman.

The "Narrows" on Yuba River: View looking upstream.

Caminetti Act providing for a more equitable and feasible method for repayment of dam construction costs through the storage charges.

Pursuant to a resolution adopted August 18, 1933, by the Committee on Rivers and Harbors of the House of Representatives, the Board of Engineers for Rivers and Harbors was requested to review the reports on Sacramento River on the subject of debris control, with particular reference to the construction of certain dams and the participation or the interest of the federal government in their construction. The job was delegated, in turn, to the California Debris Commission.

After approximately a year-and-a-half's work and the expenditure of over $95,000 the commission rendered its report under date of February 13, 1935, to the Board of Engineers for Rivers and Harbors, and while finding that dams at certain specified points were feasible, physically, drew certain conclusions therein from economic and federal-interest standpoints which were considered by interested Californians to be not in accordance with the actual facts. Particular objection was raised to the statement of ''insufficient information available to accurately determine the gold content of the gravels.''

A hearing in protest of those conclusions was arranged for and held before the Board for Rivers and Harbors in Washington, on April 15, 1935. Besides Congressman Englebright and the representatives of a number of gravel-mine owners, the State Mineralogist of California by direction of His Excellency, Governor Frank F. Merriam, appeared before the board and presented both briefs and oral arguments. As a result of that hearing and their study of the reports and data relating thereto, the Board of Engineers for Rivers and Harbors, under date of May 23, 1935, rendered a report in which they reversed the conclusions of the California Debris Commission and stated:

> "After careful consideration of all available data and all factors concerned, the board concludes that construction of four storage developments essentially as planned by the California Debris Commission is economically justified and that revenue from the sale of debris storage rights will reimburse the United States for the funds advanced. * * *
>
> "The board recommends the construction, at an estimated cost of $6,945,000, of the four debris storage reservoirs in the Sacramento Basin (Upper Narrows, Dog Bar, North Fork, and Lower Ruck-a-Chucky) set forth in the plans of the California Debris Commission, with such modifications as may be approved by the Chief of Engineers, subject to the condition that work shall not be begun on any reservoir until the repayment of the capital cost thereof by the payment of taxes on material hydraulically mined from the natural bank in accordance with the provisions of Section 23 of the act to create the California Debris Commission and regulate hydraulic mining in the State of California, as amended by an act approved June 19, 1934, is assured to the satisfaction of the Secretary of War through guaranties of responsible individuals, companies and/or corporations that they will, if the reservoir is constructed, hydraulically mine under license from the California Debris Commission, material in amounts aggregating the total capacity of the reservoir for the restraint of debris."

Following the presentation of the aforementioned report there was included by amendment in the senate of the item of $6,945,000 to the Rivers and Harbors Bill, thus authorizing the construction of the four dams specified as a federal project. Although the money has not yet been actually set aside for this purpose, it is now anticipated that that final and concluding act will soon be recorded.

As the brief filed by the State Mineralogist of California at the above-mentioned hearing contains a summary of pertinent data and figures on the gold values in the gravel deposits referred to, gathered from a considerable number of sources both governmental and private (some of which are out of print), it was deemed of sufficient value to make them available to those interested in California's mineral industry by publication in this issue of CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

To the Honorable
Board of Engineers for Rivers and Harbors,
Munitions Building, Washington, D. C.

Gentlemen:

With reference to the report of the California Debris Commission under date of February 13, 1935, relative to the pending proposition for debris control on the tributaries of Sacramento River, California, pursuant to resolution by the Committee on Rivers and Harbors of the House of Representatives of the United States adopted August 18, 1933: The undersigned has personally read said report, and on behalf of the mining industry of this state we wish to take exception to certain of the conclusions therein drawn, and particularly to the statement in the "Public Notice" of said report under the same date signed by "T. H. Jackson, Colonel, Corps of Engineers, President and Senior Member," namely: "The report shows that there is insufficient information available to accurately determine the gold content of the gravels, and concludes that the problem of providing storage is a local and not a federal one."

If there is one thing that *is* well authenticated, it is the economically recoverable values in these gravels as shown by reliable evidence not only in the performance records of actual gold production from these old-river channel gravels to be found in official government and company statistics, but also in data published in the reports of the State Mining Bureau of California and of the United States Geological Survey based upon first-hand field examinations and studies. These reports are well known and available to the members of the California Debris Commission, which fact leads one to the immediate and inevitable conclusion that these value data have at least been unjustly discounted if not disregarded in this latest report of the Commission to the Chief of Engineers.

The undersigned has been a member of the staff of the State Mining Bureau (now Division of Mines of the Department of Natural Resources) of California for over 23 years, the last 6½ years as its chief, and is familiar not only with the performance records of the gold-bearing gravel deposits of the state, but with the examinations and reports made upon the potential resources here as yet unworked. He was also vice-chairman (and now chairman) of the Mineral Resources Section of the Commonwealth Club of California when that organization made a several months' study in 1927-1928 of the hydraulic mining situation and its potentialities. At that time, outside of two or three old-time, die-hard members of the Anti-Debris Association from Marysville and Yuba City, practically the only person to express a pessimistic or antagonistic attitude was the present senior officer of the Debris Commission, who attended several of our discussions.

Referring to specific portions of this latest report of the California Debris Commission, (which we will designate the "Jackson Report" for simplicity of reference), on pp. 12 *et seq.* concerning Estimates of

Quantities, following a listing of some of the earlier reports, both of federal and state, we quote:

"In view of the fact that funds were not available for anything but casual field examinations which in no case included such determination of values as can be obtained only by comprehensive use of adequate sampling methods (such as test borings, shafts, drifting, etc.), all of these estimates were, of necessity, simply rough approximations and must be so considered. * * * These estimates may be in error by as much as 25%."

TABULATION

	1	2	3	4	5	6
River	Present est.	State of Cal. Min. Com. 1927	Whitney Rep. 1879	Mendell Rep. 1881	Heuer Rep. 1891	Lindgren Rep. 1911
Middle Yuba	320	442			147	
South Yuba	68	94	700—		283–313	400+
Bear	53	33		50	121–227	
North American	87	95	109–149	63	93	
Middle American	76	21			58	
Totals	604	685			703–838	

1. Present Rep. 2. Jarman (State of Cal.). 3. Aurif. Grav.—Whitney. 4. Chief of Eng. 1881-1882 (House Doc. 98). 5. Chief of Eng. 1891 (House Doc. 267). 6. U. S. G. S. Prof. Paper 73.

"The controlling elements in hydraulic mining are gold yield, cost of mining, and cost of storage. The gold yield estimate as submitted herein is largely a matter of judgment and is based upon surface conditions and past production records. Actual check of values in the unworked gravel has not been possible. The cost of mining as estimated is approximate and there is great variation at different mines. The estimates of storage costs are believed to be within fairly close limits."

Under *Storage* (p. 15) a 20-year period is assumed for amortization cost.

"The estimated amounts of gravel that will be mined annually over a period of 20 years are as follows:

Watershed	*Approximate average amount workable annually, mill. cu. yds.*	*Approximate amount workable under 20-year program, mill. cu. yds.*
Middle Fork Yuba	3.0	60
South Fork Yuba	2.9	58
Bear	1.3	26
North Fork American	1.3	26
Middle Fork American	1.2	24
Total	9.7	194

Discussing *Costs,* (pp. 19–20) the Jackson report includes debris storage at "$0.04 per cubic yard," which is nearly double the estimates of others as we will show later.

"It is estimated that present cost of mining ordinarily ranges from 6 to 16 cents per cubic yard excluding debris storage, and that the general average is approximately 10 cents per cubic yard."

Value of Gravels (pp. 20–21).

"Available data is not sufficient to determine with any degree of accuracy the value of gravels of the watersheds in question. Records of former mining are incomplete. Those which could be checked by mint returns on yardage mine amounted to somewhat less than 2,000,000 cubic yards, and indicated a gold recovery (at a gold value of $20.67) ranging from about 2¢ per yard to about 70¢. The yardage mined varied from about 3,000 cubic yards to about 450,000 in individual cases. The records of only one mine operating over a period of 20 years or more are available, the other records extending from one to four years. Eliminate two mines showing unusually high returns, the average values for the others amounts to approximately 12.6¢ per cubic yard with gold at $20.67 per ounce, for about 1,200,000 cubic yard mined."

Reference is made to the Jarman report, quoting a tabulation of gold yield by rivers showing average values of 11½ cents for approximately 200,000,000 cubic yards; also to private reports on San Juan Ridge giving 408,000,000 cubic yards averaging 10.3 cents and 25,000,000 cubic yards at 28 cents; also private reports on American River showing 40,000,000 cubic yards at 18 cents.

"It is considered that none of the above reports are based on sufficient data to make them more than intelligent estimates. They are offered here simply to indicate probable values."

"Plan of Improvement. After a detailed study of the above (details of each dam site considered), the Commission decided that the most advantageous plan is that of providing for a storage reservoir at each of the following sites: The Upper Narrows on the Yuba River, the North Fork Site on the North Fork of the American River; the Lower Ruck-a-Chucky Site on the Middle Fork of the American River; and the Dog Bar Site on the Bear River.

"In deciding upon this plan, consideration was given to the possibility of conflicts with the interests of the California State Water Plan, as it is believed that no interference will result. State officials have expressed the opinion that the debris development plan is not detrimental to the State Water Plan interests."

Under *Navigation* (pp. 35–36), quoting the Gilbert report that debris and soil erosion in Sacramento River amount to 12,000,000 cubic yards annually, the Jackson report states:

"the data available indicated that it is too small and indefinite of determination to warrant serious consideration in the present problem."

Under *Irrigation and Flood Control* (p. 37).

"None of the reservoirs will have any appreciable effect on irrigation or flood control."

Price of Gold. It is acknowledged that under the new price of gold ($35 per fine ounce against $20.67), former 10¢ per yard gravels are now worth $0.1693 per cubic yard.

Power (p. 37).

"A comprehensive investigation of power possibilities at Upper Narrows Dam site showed that power can be developed that would net a substantial surplus revenue if sold at or even considerably below the present competitive rates."

Under *Discussion* (pp. 39 *et. seq.*), the opinion is stated that opposition from the agriculturists has been principally based upon the fear that if the debris is not properly controlled the early damage will be repeated, but that this opposition is not now so pronounced as formerly.

"Present opposition is based more upon the argument that the mining would not pay and that any assistance furnished by the governmental agencies would be, in fact, a subsidy."

* * *

"No objection to the hydraulic mining and debris storage plans have been offered by the Power and Irrigation interests in areas under consideration.

"It is believed that debris storage, as contemplated, could be accomplished without material interference with any future water storage."

* * *

"There are three major features involved: 1. the investigation of the cost of storage for the mining debris. (2) the cost of operations at the mine and (3) the value of the gold content of the gravel.

"The investigation of the storage problem disclosed nothing difficult of solution. It proved conclusively that storage ample for all practicable mining can be secured on the Yuba, Bear, and American Rivers. The cost on a basis of complete amortization of all construction, maintenance and operation costs in a period of 20 years, should vary from about 3.87 cents to 4.84 cents per cubic yard with an average cost of about 4.57 cents per cubic yard. This latter figure may well be used in any general consideration of the basic problem.

"The investigation of the cost of operation at the mine, however, discloses many factors regarding which definite data are not available, and cannot be made available within the scope of this survey, or which is of confidential nature and not available to the public. * * * * (e.g. character of gravel, available water, value of mining property, water rights, promotion overhead, etc.).

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINES

PLATE V.

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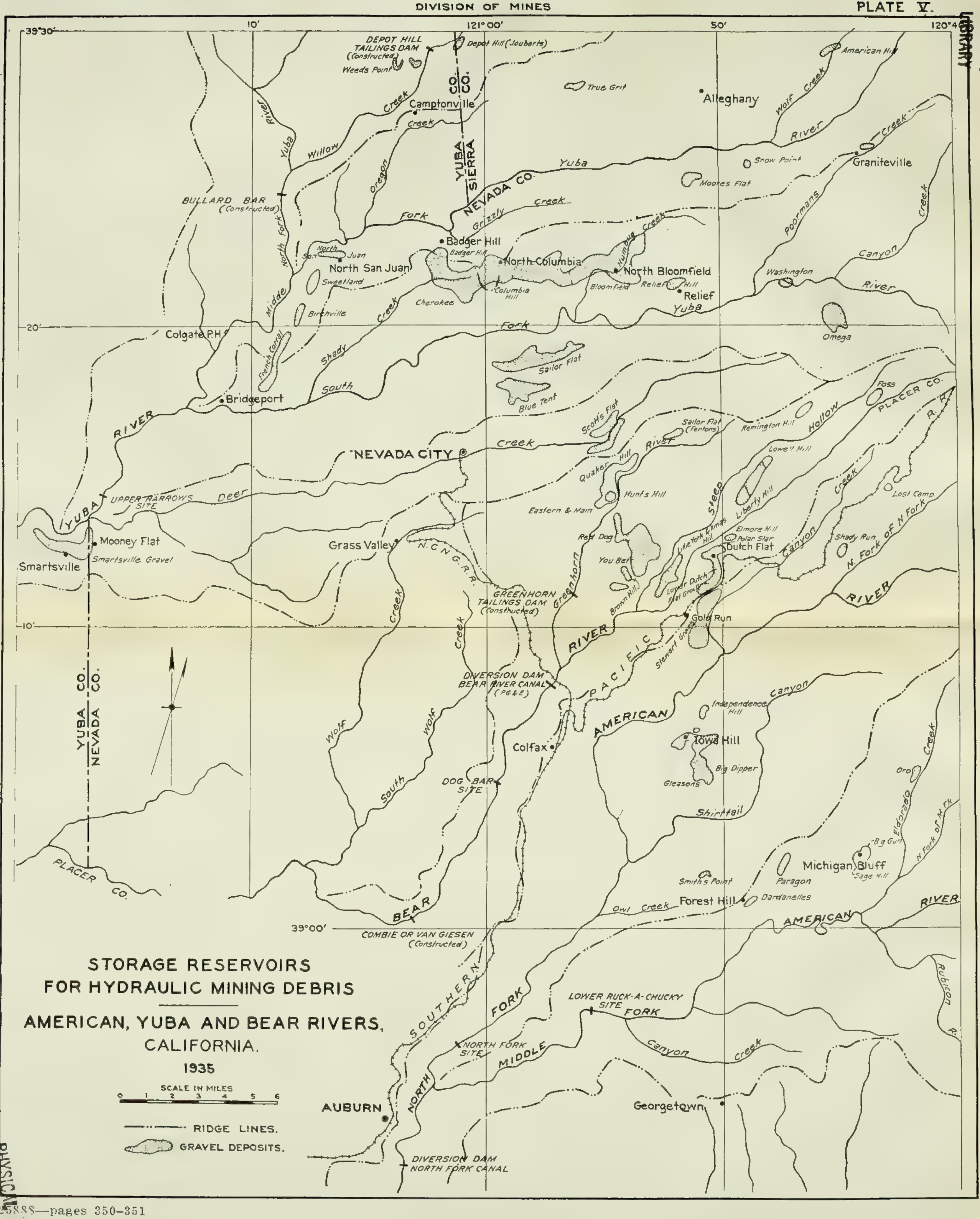
39°30'
10'
121°00'
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DEPOT HILL TAILINGS DAM (Constructed)
Depot Hill (Jouberts)
Weeds Point
YUBA CO.
SIERRA CO.
True Grit
Alleghany
American Hill
Wolf Creek
Camptonville
Creek
Willow Creek
Yuba River
Oregon Creek
River
Yuba
Snow Point
Graniteville
Creek
NEVADA CO.
Moores Flat
Poormans
Creek
BULLARD BAR (Constructed)
North Fork
Fork
Grizzly Creek
Humbug Creek
Badger Hill
North San Juan
North Columbia
North Bloomfield
Relief
Relief Hill
Bloomfield
Columbia Hill
Sweetland
Middle
Birchville
Cherokee
Shady Creek
Washington
Canyon
River
Yuba
Omega
Colgate P.H.
Fork
French Corral
Sailor Flat
Blue Tent
South
Bridgeport
RIVER
Foss
PLACER CO.
Remington Hill
Hollow
R. R.
Scott's Flat
Sailor Flat (Fentons)
River
NEVADA CITY
Creek
Lowell Hill
Quaker Hill
Hunts Hill
Creek
Lost Camp
Liberty Hill
Steep
YUBA
UPPER NARROWS SITE
Deer
Eastern & Main
Little York & Xmas Hill
Elmore Hill
Polar Star
Dutch Flat
Shady Run
N. Fork of N. Fork
Canyon
Red Dog
Mooney Flat
Smartsville
Smartsville Gravel
Grass Valley
N.C.N.G.R.R.
You Bet
Greenhorn
Lower Dutch Flat Group
Brown Hill
GREENHORN TAILINGS DAM (Constructed)
RIVER
Gold Run
RIVER
Creek
Creek
Stewart Group
PACIFIC
DIVERSION DAM BEAR RIVER CANAL (PG&E)
YUBA CO.
NEVADA CO.
Independence Hill
Canyon
AMERICAN
Wolf
Wolf
Colfax
Iowa Hill
Big Dipper
Gleasons
South
DOG BAR SITE
Creek
Oro
Shirttail
Eldorado
N. Fork of M. Fk.
Big Gun
Michigan Bluff
Sage Hill
Paragon
Smith's Point
PLACER CO.
Owl Creek
Forest Hill
Dardanelles
RIVER
BEAR
AMERICAN
COMBIE OR VAN GIESEN (Constructed)
SOUTHERN
FORK
LOWER RUCK-A-CHUCKY SITE
FORK
Rubicon R.
NORTH FORK SITE
MIDDLE
Canyon Creek
NORTH
AUBURN
Georgetown
DIVERSION DAM NORTH FORK CANAL
SCALE IN MILES
0 1 2 3 4 5 6

STORAGE RESERVOIRS FOR HYDRAULIC MINING DEBRIS

AMERICAN, YUBA AND BEAR RIVERS, CALIFORNIA.

1935

RIDGE LINES.

GRAVEL DEPOSITS.

PHYSICAL SCIENCES LIBRARY

P. 42.

* * *

"practically no operations of even moderate size have been carried on in the area concerned in recent years. Based, however, on its experience with the minor operations of the past 40 years, on the data which it has been able to collect, and on certain confidential data furnished by operators, with experience in recent years operations, the Commission believes that the cost of operation at the mine will average 10 cents. This figure is based upon the assumption that an adequate water supply is obtainable without excessive cost.

"In the investigation of the value of the gold content of the gravel, even greater difficulties were experienced than in the investigation of the cost of operations at the mine. In this case the necessary data are not available and cannot become available except following a complete examination by means of suitable sampling methods of all important gravel deposits within the area. The existing data are too limited to justify an intelligent estimate of the value of the gravel in the major deposits. It should be practicable, however, to obtain the desired information through sampling operations, at a small cost in comparison with the estimated gold content.

"The Commission does not believe that there is justification for the development in any major gravel deposit without such an investigation, and sampling of the deposit as will determine that the gravel contains gold of such value per cubic yard as will warrant a reasonable return on the basis of an average cost of production at 10¢ per cubic yard and for storage at 4¢ per cubic yard, or a total of 14 cents per cubic yard.

"Nor does the Commission believe that there is justification for any interest, owner, state or federal, or a combination of same, to provide storage facilities for mining debris at any point, until there is conclusive proof that gravel deposits of at least the extent of the storage contemplated have such a value.

"The fact that debris storage has been available at Bullard's Bar Reservoir on the N. Yuba River and at Combie Reservoir on the Bear River appears to refute the contention of miners in the past that operations were dependent on low storage costs.

"The outstanding reason advanced by the local operators that the State or Federal Government should furnish the funds necessary to provide the desired storage is that it is impracticable for the operators to finance the cost.

"Based on its many years of experience with parties securing licenses to operate, the Commission cannot agree with the operators on this point. It believes the outstanding reason why capital has not been interested in hydraulic gold mining is the almost complete lack of data covering the values of the larger gravel deposits.

* * *

"On the basis of the above, the Commission considers that there is no prospect of such profitable operations as might interest the investing public where there cannot be obtained proof that the recoverable gold value is more than 17 cents on the basis of the present value of the gold."

Under *Conclusions* (pp. 44–45), four damsites are listed as being the most practical for storage of debris, with their estimated costs, capacities, and maintenance, as follows:

"1. Upper Narrows on Main Yuba River; cost $3,621,400; maintenance and operation capitalized at $247,000; amortization, 20 years at 4.84¢ per cubic yard on 117,700,000 cubic yard storage.

"2. Dog Bar Site on Bear River; cost $646,700; maintenance and operation $65,300; amortization, 20 years, at 4.05¢ per cubic yard for 25,900,000 cubic yard storage.

"3. North Fork Site on North Fork American River; cost $715,380; maintenance and operation $60,000; amortization, 20 years, at 4.55¢ per cubic yard for 25,000,000 cubic yard storage.

"4. Lower Ruck-a-Chucky site on Middle Fork American River; cost $598,800; maintenance and operation $55,100; amortization, 20 years at 3.87¢ per cubic yard, for 24,900,000 cubic yard storage.

* * *

"Should storage be provided at any point the charge per cubic yard should be such as will permit complete amortization" on same basis as above.

"There is economic justification for the providing of storage reservoirs at the four sites indicated in the plan of improvement if the average value of the gravels tributary to the site is at least 17 cents per cubic yard at the present price of gold."

At the outset of this present statement we made the assertion that the fact of economically recoverable gold values in the gravel deposits under discussion is well authenticated. While the list is not extensive, the publications containing data and information on the subject of hydraulic mining in California, gravel values, disposal of debris, and other problems involved, include federal, state, and privately published documents. The more important ones are:

Bowie, A. J., Jr. "A practical treatise on Hydraulic Mining in California," pp. 70–75, 1902 (relative to distribution of gold in gravels).

Browne, Ross E., "The Ancient River Beds of the Forest Hill Divide,": State Mineralogist's Report X, California State Mining Bureau, pp. 435–465, 1890.
"The Channel System of the Harmony Ridge, Nevada County: State Mineralogist's Report XII, p. 202, 1894.

Commonwealth Club of California, Trans. Vol. 23, No. 5 pp. 139–207, 1928.

Dunn, Russell L., "Drift Mining in California": State Mineralogist's Report VIII, California State Mining Bureau, pp. 736–770, 1888.

Gilbert, G. K., "Hydraulic-mining debris in the Sierra Nevada": U. S. Geological Survey, Professional Paper 105, 155 pp. 1917.

Haley, Chas. S., "Gold Placers of California": Bulletin 92, California State Mining Bureau, 167 pp. with map, 1923.

Hammond, John Hays, "The Auriferous Gravels of California": State Mineralogist's Report IX, California State Mining Bureau, pp. 105–138, 1889.

Hobson, J. B. "Placer County": State Mineralogist's Report X, California State Mining Bureau, p. 414, 1890.

Hydraulic Mining Commission of California: Report to the Legislature of 1927 "Upon the Feasibility of the Resumption of Hydraulic Mining in California" ("Jarman Report"), 85 pp. wth map, 1927. Reprinted in State Mineralogist's Report XXIII, pp. 44–116, 1927.

Lindgren, Waldemar, "The Tertiary Gravels of the Sierra Nevada of California": U. S. Geological Survey, Professional Paper 73, 226 pp. with maps, 1911.

Reports of Chief of Engineers, U. S. Army.
House Ex. Document No. 98, 47th Congress 1st Session 1882 ("Mendell Report").
House Ex. (Document No. 267, 51st Congress 2d Session, 1882 ("Heuer Report").

Whitney, J. D., "The Auriferous Gravels of the Sierra Nevada": Mem. Mus. Comp. Zool., Harvard Coll., Vol. 6, 569 pp., 1879. Includes chapters by W. A. Goodyear and W. H. Pettee.

Additional bibliographic references are given by Lindgren in U. S. Geological Survey, Professional Paper 73, pp. 12–13.

Please note in the last paragraph quoted above from the ''Jackson report'' the conclusion is stated that there is economic justification for the construction of dams at four suggested sites

> "if the average value of the gravels tributary to the site is at least 17 cents per cubic yard at the present price of gold."

Figures which we quote in subsequent paragraphs prove values of 10.3 cents per cubic yard in the largest of the low-grade deposits at the old price of gold ($20.67), which is equivalent to between 17 and 18 cents on the new price. On its own basic figure, then are the Jackson report's other conclusions as to lack of Federal interest in financing deprived of weight.

Chas. S. Haley in ''Gold Placers of California'' (Bull. 92, California State Mining Bureau, 1923) in his Foreword says:

> "In spite of the fact that the gold placers of California have produced over a billion dollars since their discovery in 1848, the idea that they are now completely exhausted is entirely erroneous, * * *. The principal gold placer area of California lies in the Sierra Nevadas between Susanville on the north and Mariposa on the south. This area is the one that is restricted by the present debris law. * * * From investigations thus far, it seems fairly safe to assume a total of about seven billion yards of gravel distributed among the different drainage areas, as follows approximately: Feather River 500,000,000 yards; Yuba River 3,500,000,000 yards; Bear and American rivers 2,500,000,000 yards; Mokelumne, Consumnes, Calaveras, Tuolumne and Stanislaus rivers 500,000,000 yards. The above figures include both drift and hydraulic ground.
>
> "The above total of 7,000,000,000 yards is of course not all available for working from an economic standpoint. It is fairly safe to assume that at least 40 per cent of this, due to its location and elevation with regard to available water, is not feasible for working. This leaves, roughly, about 4,000,000,000 yards, which, judging from past performance in the days of unrestricted mining, should yield an average of about 15 cents a yard; and if hydraulic mining is restored under proper restrictions with regard to controlling of debris, there is, roughly in the neighborhood of $600,000,000 to be recovered from these drainage systems alone.
>
> "A perfectly feasible plan for the working of this ground, under the provision of the Caminetti Act, is now suggested and is to some extent now being carried out by private corporations. Should the work be amplified to cover the whole drainage system, it should properly be under the control of the national and state governments in conjunction.
>
> "Briefly, the plan would consist of the erection of concrete debris dams at controlling points on the Feather, the Yuba, the Bear, the American, the Cosumnes, the

Mokelumne, and the Calaveras rivers. These dams will take care, not only of the hydraulic miners' debris, but also of the natural erosion, which is now being carried into the Sacramento and San Joaquin rivers by their tributaries, regardless of the restriction and even elimination of hydraulic operations.

"By various independent investigators it has been estimated that the debris carried down from natural erosion is from 100 to 200 per cent greater than the amount caused by the mining operations. * * *

"The advantages to the State of California which would accrue from a construction of these works would be tremendous. * * *

"The expense of dredging and keeping the channel clear on both the Sacramento and the San Joaquin would gradually be eliminated. The necessity of building levees would be gone in a few years, and the direct expenditure saved to the taxpayers of this State and those of the nation would be considerable. The fact of easily available transportation of the farming products of the Sacramento Valley to centers of distribution would result in lowering the cost of farm products to the consumer."

Specifically, in the case of the ancient Yuba Channel on San Juan Ridge in Nevada County, Haley says:

"This area probably contains the largest possible hydraulic mine yet remaining in the State of California. Gravels are from three hundred to six hundred feet in depth, and bedrock has not been exposed in the center of the channel during practically the entire length of seven miles. This is undoubtedly the largest single body of commercial hydraulic gravel in the State of California. It is mostly owned by one company and contains anywhere from eight hundred million to twelve hundred million yards of gravel, which will run, according to the records of former operations, in the neighborhood of twelve to fifteen cents a yard. In the Malakoff diggings on the upper end of this body of gravel drifting operations in the past two years have shown values running better than $25 a yard on and near bedrock. In 1917 the ground from North Columbia down to Badger Hill was prospected by Keystone drills very extensively.

"The values in this gronud may roughly be estimated from the fact that the old washings of surface ground near Malakoff from 1870 to 1874 were estimated at about 3,250,000 cubic yards, the yield of which was in the neighborhood of three cents per cubic yard. In 1876 and 1877 about 1,600,000 yards were washed, which yielded about four cents per cubic yard. This, of course, was top gravel. At the same time the company washed about 700,000 yards of bottom gravel, which yielded about thirty-three cents per cubic yard. The bottom gravel extended from bedrock upward about seventy feet. The top gravel averaged from thirty feet to over two hundred feet in depth."

In a report on Placer County mineral resources in 1890, J. B. Hobson (State Mineralogist's Report X, p. 414) states:

"Taking into consideration the fact that there are within the county limits about two hundred miles of unworked auriferous gravel channels and an immense area of auriferous metamorphic rock, in which are great numbers of veins of auriferous quartz, and basing an estimate of the amount of gold yet remaining in the unworked channels on the result obtained from channel workings at Forest Hill, Iowa Hill, Deadwood, Last Chance, Canada Hill, Dutch Flat, and some deep channel workings between Rocklin and the American River, varying from about $100 to $1,000 per linear foot of channel worked and equal to a product varying from about $500,000 to $5,000,000 per mile, it is evident that the amount of gold already extracted is but a trifle compared with the amount remaining in the ancient river channels and quartz lodes."

In another section of the same volume (X) of the State Mineralogist's reports, Ross E. Browne in a report on "The Ancient River Beds of the Forest Hill Divide," gives (p. 459) average gross yields per linear foot of channel in the Paragon mine (worked in part by drifting, and in part by hydraulicking) of $125 on the "bottom lead" and $300 in the "upper lead"; and average gross yields per ton of gravel delivered to surface, of $10 and $4.50, respectively. The Paragon at that time had been worked for 28 years.

John Hays Hammond ("The Auriferous Gravels of California," State Mineralogist's Report IX, pp. 111–113, 1889), describing the characteristics of the gravel channels and the distribution of the gold:

"The width of channel worked in hydraulicking varies from one hundred and fifty to one thousand feet. * * * The larger channels are usually less 'spotted' as regards the value of the gravel than the smaller channels. * * * The old washings of surface ground near Malakoff, Nevada County, from 1870 to 1874, is estimated at about three million two hundred and fifty thousand cubic yards, the yield of which was about 2 9/10 cents per cubic yard. The Bloomfield Company, from November 29, 1876, to October 13, 1877, washed one million five hundred and ninety-

> one thousand seven hundred and thirty cubic yards of top gravel, which yielded 3 8/10 cents per cubic yard. During the same period that company washed seven hundred and two thousand two hundred cubic yards of bottom gravel, which yielded 32 9/10 cents per cubic yard. The bottom gravel extended from bedrock to a height of 65 feet. All the gravel above that horizon was considered as top gravel.
>
> "The depth of the top gravel varied from a few feet to over 200 feet.
>
> "The steep bedrock is more favorable for rich gravel than where the bedrock is flat, but often the gravel is poor where the channel is narrow and steep.
>
> "Gravel that yields remunerative results by the drift process has been worked in some instances from 60 to 150 feet above bedrock. The coarser gravel ('heaviest wash') is the richest. The light 'wash' and material of a sandy character, is usually poor in gold. The top gravel of hydraulic mines rarely pays for piping, unless worked in conjunction with the underlying richer auriferous deposits. The gold is often found in the grass roots of the vegetation covering the gravel deposits, but not in considerable quantities. The top gravel of a deposit is usually richer than that lying a foot or two below the surface, owing to the concentration of the gold superficially."

As to "duty" of water in hydraulicking Hammond (p. 126) quotes the State Engineer's estimates of from 3 to 4½ cubic yards per miner's inch with an average of 3.6.

As to efficiency of recovery, he says:

> "Of course, an appreciable amount of gold must inevitably escape as flour gold, rusty gold, and amalgam. * * *
>
> "* * * The examinations of many tailings cañons, into which the debris from the gravel mines washed lead me to believe that but a small percentage of the gold is lost. It is often asserted that not more than one-half of the gold in the gravel bank is saved by this method of mining. In the opinion of the writer, in most well conducted hydraulic and drift mining operations, at least 85% and in many cases upward of 95% of the gold tenure of the gravel is saved. Mr. Louis Glass, formerly the manager of the Spring Valley Mines, is of the opinion that not more than 5% of the gold passed off in the tailings.

TAILINGS

> "By far the greater portion of the material washed from the banks finds lodgment within a short distance of the tailings' dump of the mine. * * * The cost of the construction and maintenance of a system of dams and of the canals for disposing of the 'slickens' would be of no moment, as compared with the beneficial result of hydraulic mining."

From his tabulation of "Yield of Gravel at Important Hydraulic Claims in California According to Verified Reports," (pp. 134–135) the following are taken for mines in the northern section:

Name of claim	Location	Cubic yards washed	Gross yield	Yield per cubic yard	Height of banks in feet	Report of	Remarks
American Co.	Sebastopol, Nevada Co.	5,171,834	$1,241,240 30	$0 24.0	120	H. Smith, Jr.	
No. 8-1870-74	North Bloomfield, Nevada Co.	3,250,000	94,250 00	2.9	150	H. Smith, Jr.	Paid a profit of $2,232.84.
No. 8-1874-75	North Bloomfield, Nevada Co.	1,858,000	74,271 77	3.9	180	H. C. Perkins	The North Bloomfield produced, from 1867 to 1880, $1,435,680.47; the mining profits were $411,589.27. Hammond.
No. 8-1875-76	North Bloomfield, Nevada Co.	2,919,700	192,735 73	6.6	260	H. C. Perkins	
No. 8-1876-77	North Bloomfield, Nevada Co.	2,293,930	290,775 42	12.7	265	H. C. Perkins	
North Bloomfield	North Bloomfield, Nevada Co.	30,000,000	2,610,000 00	8.7	150–350	H. C. Perkins	
French Corral	French Corral, Nevada Co.	4,200,000	1,745,500 00	41.5	20–100	H. C. Perkins	The greater part of the top gravel had been removed previously.
Manzanita	Sweetland, Nevada Co.	5,780,000	1,489,000 00	26.0	50–150	H. C. Perkins	About one-third of the top gravel had been removed previously.
McCarty's	Columbia Hill, Nevada Co.	3,000,000	345,663 10	4.3		J. D. Hague	
Blue Point	Smartsville, Yuba Co.	93,944	115,728 17	1 23.0	57	H. Smith, Jr.	
Green Flat	Plumas Co.	22,000	15,000 00	67.5	15	A. J. Bowie, Jr.	
Fale's Hill	Plumas Co.	25,000	4,794 49	19.0	75	A. J. Bowie, Jr.	
Crawford's	El Dorado Co.	77,880	35,046 00	45.0	85	J. J. Crawford	
Gold Run District	Placer Co.	43,000,000	2,074,356 00	4.8	?	W. H. Pettee	

On page 138, Hammond gives the following

"Details of Work at No. 8 Claim, North Bloomfield Company":

	1874–5	*1875–6*	*1876–7*
Cubic Yards of Gravel Moved	1,858,000	2,919,700	2,293,900
Yield, per cu. yd.	3.99 cents	6.60 cents	12.68 cents
Expenses, total, per cu. yd.	2.86 cents	3.25 cents	6.10 cents

A. J. Bowie, Jr., ("A Practical Treatise on Hydraulic Mining in California," p. 74, 1905), also speaking of the North Bloomfield, says:

"From 1870 to 1874 the North Bloomfield Mining Company washed three and one-quarter million cubic yards of top gravel, which yielded only 2.9 cents per cubic yard and a gross profit of $2,232.84. In 1877 a rough estimate was made of the comparative yield of the upper and lower gravel washed during the year. The top gravel was assumed to be from a few feet to over two hundred feet deep, and the bottom gravel sixty-five feet deep.

"The results obtained were that 1,591,730 cubic yards of top gravel yielded 3.8 cents per cubic yard, and 702,200 cubic yards of bottom gravel returned 32.9 cents per cubic yard."

Waldemar Lindgren ("The Tertiary Gravels of the Sierra Nevada of California," U. S. Geological Survey Professional Paper 73, 1911), on the subject of the distribution of the gravels and their gold contents, says, (pp. 65–66):

"In Sierra, Yuba, and Butte counties the Tertiary channels are rich in gold almost up to the divide of the range, the conditions corresponding to those outlined above. In Nevada County they are barren in the extreme eastern part, but soon after entering the metamorphic area they become greatly enriched, first by the Washington belt of quartz veins and second after crossing the long complex dike known as the serpentine belt. In Placer County the channels are almost barren in the eastern part but become tremendously enriched in crossing the continuation of the Washington belt of quartz veins, here appearing in the vicinity of the Hidden Treasure mine. The serpentine belt is crossed near Forest Hill and here the result is again a great enrichment. In El Dorado County the upper channels to points within a few miles of Placerville are generally poor, but at those points, where they cross the Mother Lode, coarse gold appears in enormous quantities and the enrichment continues for a considerable distance below this line. In the counties farther south similar conditions prevail. Wherever the channels cross areas rich in gold-bearing quartz veins they become heavily charged with gold. Above such deposits the channels grow rapidly poorer; below them the decrease in tenor is gradual. In Amador, Calaveras, and Tuolumne counties it so happens that most of the ancient river deposits below the great Mother Lode are either eroded or so heavily covered that they can not be mined. This great source of enrichment being absent, the general grade of the gravels in these counties is lower than in those farther north.

* * *

DISTRIBUTION OF THE GOLD IN THE GRAVELS

"It has become almost an axiom among miners that the gold is concentrated on the bedrock and all efforts in placer mining are generally directed toward finding the bedrock in order to pursue mining operations there. It is well known to all drift miners, however, that the gold is not equally distributed on the bedrock in the channels. The richest part forms a streak of irregular width * * * The gravel outside of the 'pay streak' would ordinarily be regarded as extremely rich by the hydraulic miner, who would be content with a yield of 10 cents a cubic yard; but the drift miner is obliged to leave as unpayable gravel containing from 75 cents to $2 a cubic yard. Fig. 12 (p. 151) illustrates the position of the pay lead in the Mayflower channel, according to Ross E. Browne."

Under tenor of the gravels, he states (pp. 70–71):

"The productiveness of a channel is best measured by its yield per linear foot. A distinction must of course be made as to whether the hydraulic method is employed and thus the whole amount of gravel is washed or whether only the rich bottom layer is mined by drifting. In general it may be said that the channels yield from $70 to $500 to the linear foot; in drifting operations rarely more than half of the total amount of gold contained in the gravel is obtained, for besides the inaccessible gold in the upper gravels there are usually considerable bodies of gravel on the bedrock of too poor grade to pay for extraction.

* * *

"In the following paragraphs a few data regarding the grade of the gravels are assembled from the detailed descriptions in Part II of this report.

"At Morris Ravine, near Oroville, the best drifted ground yielded from $4 to $9 a cubic yard; this is a minor channel. A main branch of the Tertiary Yuba River at Poverty Hill, Sierra County, yields $2 a cubic yard within 5 or 6 feet from bedrock; the lower 2 feet contains most of the gold, but much is also derived from the upper part of the section. At La Porte, Plumas County, the deep gravels yielded from $2 to $20 a cubic yard. According to W. H. Pettee, one bank of gravel, covering an area of 250 by 100 feet and 30 feet high, yielded at the rate of $21 a ton. Most of the gold is said to be within 2 feet of the bedrock. At North Bloomfield, Nevada County, the gravels average between 200 and 300 feet in depth. The upper 120 feet of fine gravel contains small values but a considerable number of pieces of scaly gold of little value or weight. The lower 87 feet contains most of the gold, and the last 8 feet above the bedrock yields high values, averaging about $1.50 a ton. A large amount of the upper gravel at North Bloomfield, washed from 1870 to 1874, yielded, according to A. J. Bowie, Jr.,[1] 2.9 cents a cubic yard. This work afforded practically no profits. In 1877 the bottom gravel, 65 feet deep, was found to yield 32.9 cents a cubic yard, but the top gravel, which was up to 200 feet deep, yielded only 3.8 cents. The Derbec drift mine, near North Bloomfield, working on a branch of the same channel, mined gravel from which $2.47 a ton was recovered.

"The thick gravels between Dutch Flat and Indiana Hill are stated to yield 11 cents a cubic yard; the cemented gravel on the bedrock at Indiana Hill up to $9 a yard.

"Rich hydraulic ground was found in the gravel areas extending from North San Juan, in Nevada County, to Smartsville, in Yuba County; large masses of them, with banks up to 150 feet in height, are said to have yielded from 30 to 37 cents a cubic yard. Between Cherokee and North Columbia, below North Bloomfield in Nevada County, the gravels are up to 600 feet in thickness and very extensive; these top gravels are said to contain from 10 to 15 cents a cubic yard. At Omega, Nevada County, where the hydraulic banks reach 150 feet in height, the yield is said to be 13½ cents. At Blue Tent, Nevada County, the upper gravels and sands are practically barren, but the lower gravels are said to contain 15 cents a cubic yard. At this place the channel is 1,000 feet wide, and 5 feet of gravel next to the bedrock is stated to contain 50 cents a ton.

* * *

Rich gravels were also mined near Placerville. At the Excelsior claim a considerable mass of gravel 100 feet in thickness is stated on reliable authority to have averaged $1 a cubic yard, worked by the hydraulic method. At this place two upper pay streaks occurred, one 25 feet and the other 60 feet above the bedrock. The deep gravel of the so-called blue lead at Placerville, averaging about 100 feet in width, yielded cemented gravel containing from $2 to $3.50 a cubic yard. From Smith Flat to White Rock many rich benches produces gravel containing as much as $19 a carload, which is somewhat less than a ton.

"In Calaveras County the gravels are ordinarily of somewhat lower grade, although, of course, many rich localities were found. The gravel in the Deep Blue lead of Mokelumne Hill, at the North Star mine, is said to average $1.95 a ton in drifting operations. At the Banner drift mine, on the Fort Mountain channel, the bottom gravel is said to contain $3 a ton, and the costs of mining and milling are given as $1 to $1.25 a ton."

In the Bidwell Bar Quadrangle, Lindgren (p. 101) records.

"Large hydraulic operations were carried on at the isolated deposit at Brandy City and at the large body of gravels at Scales until the opposition to this kind of mining stopped work about 1891.

"G. F. Taylor, superintendent of the Brandy City Mine states (Eng. and Mining Journal, p. 1152, June 4, 1910):

"The channel has a width of pay gravel varying from 300 to 700 feet, and there are about 10,000,000 cubic yards yet to be mined. The bulk of this lies at the northern end of the claims. The gravel here has a thickness of about 150 feet, with an overburden of 60 feet of cement lava (andesite breccia). * * * (Note: The bottom stratum is tight and requires blasting). Aside from the overlying lava ash, the whole deposit is pay gravel carrying near the surface about 10 cents in gold per cubic yard, and near the bedrock as high as $2.50 per cubic yard. In the spring of 1909 about 30,000 cubic yards of the upper part of the gravel was hydraulicked and 10 cents per cubic yard recovered. This gravel came from the east rim of the channel, 60 feet above bedrock. The general average of the gravel is estimated, from the old records, as 25 cents per cubic yard.

"The cost of mining 500,000 cubic yards of gravel per year is estimated * * * total $50,000" (or 10 cents per cubic yard)."

In the Downieville Quadrangle, according to Lindgren (p. 103).

"A large amount of gravel suitable for hydraulic work still remains in the western part of the Downieville Quadrangle, although it is not more than the quantity that has already been washed. The Army engineers reporting on the debris question made the following estimate ("Heuer Report," 1891), to which it is proper to add that much of the gravel remaining is probably of lower grade than that already worked."

The gravels referred to are in the basin of North Fork of Yuba River and the tabulation shows totals of 82,750,000 cubic yards excavated; and remaining—62,025,000 cubic yards "available at present," with 99,325,000 cubic yards "ultimately available."

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[1] Hydraulic mining in California, 1885, p. 74.

In the Smartsville Quadrangle (Lindgren, p. 171).

"The yield from the Neocene gravel mines at Nevada City and along the main Neocene River from North Columbia to French Corral has been very large. * * * the quadrangle does not contain any reserves of great value for future hydraulic or drift work, except at French Corral, Nevada City, Badger Hill, and Cherokee."

He then quotes in a tabulation figures of the Army engineers ("Heuer Report," 1891) showing hydraulic gravel in the above noted basin of Yuba River with totals: 194,510,000 cubic yards "excavated"; 56,050,000 cubic yards "available at present"; 252,650,000 cubic yards "ultimately available."

"The measurements by G. K. Gilbert show that the volumes excavated are for the most part considerably greater than the figures here given. * * *

"As to the yield of the heavy gravels along the main stream from Smartsville to French Corral, few data are available, and most of those which follow are taken from Whitney's "Auriferous gravels."

"The thick gravels from Cherokee to French Corral contain gold throughout; even the top gravels at Cherokee are profitable by the hydraulic method and yield 10 to 15 cents a cubic yard in fine gold. At American Hill, below North San Juan the channel has been worked for 3,000 feet, the width from rim to rim being about 1,000 feet, the thickness averaging 150 feet. The gross product from 1860 to 1872 was, according to Whitney, $1,241,240. Pettee says that the gravel averaged 30 cents to the cubic yard. The lower end of the San Juan Hill yielded $157,000 in 1858, the contents averaging 35 cents to the cubic yard. This includes the bottom gravel, which is much richer than the top.

"The total yield of the Smartsville diggings up to 1877 is estimated by Pettee to have been $13,000,000; the average yield was probably 37 cents a cubic yard."

The Colfax Quadrangle (Lindgren pp. 133 *et seq.*).

"The largest and richest masses of Tertiary gravel known in the Sierra Nevada are found in this quadrangle and derived in their contents from a great number of gold-quartz veins. * * *

"It is impossible to obtain exact data regarding the total amount of gold produced in this quadrangle. * * * It is thought that $150,000,000 is a very conservative estimate of the total. Of this amount probably not more than $10,000,000 has been contributed by the quartz mines. The yield of the Nevada City and Grass Valley districts, just outside the quadrangle, is estimated at $123,000,000; of this amount about $75,000,000 may have been derived from the quartz mines in those districts. These figures are only the rudest approximations, but they serve to convey an idea of the astounding richness of the region. * * *

"The gravels at North Columbia are owned chiefly by the Eureka Lake Co., whose claims cover an area of 1,445 acres along 2½ miles of channel. * * * It is estimated that 25,000,000 cubic yards have been washed off and that 165,000,000 cubic yards remain.

"At North Bloomfield the exposures are excellent in the hydraulic bank along the center of the channel. * * *

"Hydraulic mining has been carried on at North Bloomfield on a very large scale. * * * The deposit has been opened by a bedrock tunnel 7,874 feet long, starting from Humbug Canyon. The sum of $3,000,000 is said to have been expended on this tunnel, the water supply, and other preliminary work. Shortly after completion of the tunnel hydraulic mining was suspended by injunction of the courts. * * *

"The average yield per cubic yard is from 4 to 10 cents. * * * Owing to the great width of the channel the gravel next to the bedrock is rarely rich enough for drifting. The yield of the mine from 1866 to 1900 was approximately $3,500,000. About 30,000,000 cubic yards has been excavated, and 130,000,000 cubic yards is said to remain. The same amount may be available in the vicinity of Lake City.

* * *

"West of Orleans is Moores Flat (bedrock elevation 4,010 feet) where a considerable body of gravel is exposed. * * * It is estimated that 26,000,000 cubic yards have been washed off and that perhaps 15,000,000 yards remain.

"At Woolsey Flat there is likewise a large body of gravel exposed. * * *

At Quaker Hill and Scott's Flat, "the yield of the top gravel rarely exceeds 6 cents a cubic yard in fine gold, the size of a pinhead or less, but the bottom gravel may be very rich. It is estimated that near Scott's Flat 12,000,000 cubic yards have been removed and that 35,000,000 yards have been worked at Quaker Hill, where the gravel banks reach a thickness of 250 feet. A vast amount of workable gravel, estimated at 140,000,000 yards, remains at Quaker Hill. * * *

"Extensive hydraulic mining operations were carried on at Gold Run for about 10 years, in which time perhaps $3,000,000 or more was extracted. Some 84,000,000 cubic yards has been washed off, but a large quantity, estimated at 92,000,000 yards remains. * * *

"* * * At Indian Hill, where the bedrock elevation is 2,792 feet, the bottom gravel was drifted and crushed in mills. The yield per cubic yard of hydraulic gravel is said to be 11 cents.

* * *

"Extensive hydraulic operations have removed 12,000,000 cubic yards at Omega, the tailings being discharged in Scotchman Creek through a 3,000-foot bedrock tunnel. Apparently reliable calculations give 13½ cents as the yield per cubic yard, the lowest gravel, of course, being much the richest part of the deposit. About 40,000,000 cubic yards is estimated to be still available for hydraulic mining.

* * *

"At Peckham Hill, * * * About 11,000,000 cubic yards has been washed off, the yield of which is given as $5,000,000, but this may be too high.

* * *

"It is estimated that 8,630,000 cubic yards have been removed from Georgia Hill, Yankee Jim, and Smiths Point, and that the yield has been about $5,000,000. The amount remaining available is undoubtedly less than that removed. * * *

"Dardanelles, Mayflower, and Bath. The mining operations in this vicinity have been very extensive. Hydraulic work has mainly ceased, though a considerable amount of gravel is still available at Dardanelles and around the head of Brushy Canyon."

The Report of the Hydraulic Mining Commission (of California) to the Legislature of 1927 ("Jarman Report"): the Letter of Transmittal signed by Lloyd L. Root, State Mineralogist, and W. S. Kingsbury, Surveyor General, the commissioners, contains among others the following summarizing statements:

"The investigation shows that hydraulic mining may be resumed not only without fear of damage to farming and other interests, but with positive benefit to them, provided that impounding dams be constructed at strategic points, as shown on the map of the area under consideration. Preliminary estimates show that the erection of three dams and the purchase of storage in a fourth dam at a total cost of $2,405,000 would enable this industry to be resumed on the Bear, American and Yuba rivers.

"Mr. Jarman reports that the available water will only suffice for one-fourth of the activity of the early '80's and that the shortage of water will mainly restrict work on gravels above the average in gold content. His forecast is an annual output of gold only one-seventh that formely obtained from the district described. Approximately 10,000,000 cubic yards, estimated to yield $1,156,000, would be mined annually compared with 38,610,000 cubic yards in 1880, estimated to have yielded $8,000,000."

* * *

"Benefits to be obtained by the Adoption of the Above Program.

* * *

"3. Development of additional water supplies for mining that will be stored in the higher regions and released as used for mining. This will assist all plans for water conservation at lower elevations, and tend to reduce salinity in the lower reaches of the Sacramento River.

* * *

"5. Natural debris will likewise be prevented from being carried downstream and this will benefit the navigable channels by reducing the amount of dredging required. Dredging on the Sacramento River costs 6 cents per cubic yard, and the cost of restraining debris by a dam is less than one-third of this.

"6. The Narrows Dam near Smartsville will render available considerable power and also water. The latter will be at an elevation of 520 feet, enabling it to be distributed over a large area of land with great benefit to the district below."

Jarman says (pp. 12, *et seq.*):

"A general revival is impossible because of the altered conditions of the times and because much of the water supplies that formerly belonged to hydraulic undertakings have been acquired by power and irrigation interests. Making allowance for these factors, there still remain some of the largest auriferous gravel deposits known to the mining world, and *the only process by which they can be worked at a profit is hydraulic mining*. A portion of the former water supplies is still available and would enable an industry to be built up with an annual production estimated at $1,156,950, so that in the next 20 years gold would be produced to a total value of over $23,000,000, but to accomplish this *the debris must be impounded at a low cost, otherwise more than one-half of the gravel would be unprofitable to work,* being of low grade. The provision of a substantial concrete dam on each of the main streams affords the only hope of securing impounding capacity at low cost, each dam serving several mines.

* * *

"The California Debris Commission's report upon dam sites, with their impounding capacities and preliminary estimates of costs is printed verbatim. The map that accompanies this report was prepared by them and on it are shown the chief gravels that are workable.

"1. As a result of surveys and calculations, five dam sites were found to be unsuitable because of high cost per cubic yard of impounding capacity. Six showed promise of reasonable cost per cubic yard of gravel and it is recommended that detailed surveys be made of these and that drilling be done to ascertain rock conditions. * * *

"2. The site at the Narrows on the Main Yuba requires drilling only to ascertain closely the cost of construction, but a low cost per cubic yard is assured from preliminary estimates. In this case revenue from power production and the sale of water for irrigation enables low cost to be obtained.

* * *

"It is impossible to estimate the yield from the gravels, therefore it is futile to calculate greater revenue derivable from a greater percentage charge. *A charge per cubic yard of debris discharged into the stream or channel is rational, and it is suggested that this charge be based upon the return of the cost of the dam by mining the quantity of debris allowed to be mined behind it.*

"Where there is a large percentage of heavy boulders there is no sense in encouraging the discharge of such material into the water courses. In many cases it would be cheaper to stack this on the bedrock of the mine, using an electric derrick. When this is done, the survey should make an allowance for the quantity so retained on the bedrock of the mine.

"Such heavy material would never reach the dam but might reach the main water courses; stacking it at the mine should be encouraged and not penalized; *If charged for as though retained by the dam the effect is to raise to a high figure the charge per cubic yard mined.* This is not equitable, and may prevent the earning of a profit."

(The italics are ours—W. W. B.)

And further (pp. 32 and 34):

"Result of the Present Inquiry.

"Gravel Deposits that may be Benefited.

"Although no dams have been built by the Debris Commission as forecasted by this act, and although the production for 1925 was only $175,345 of which less than one-half was from the Grand Valley, there are some remarkably fine gravels that await the solution of the present difficulty—the provision of efficient debris impounding capacity at low cost.

"In a report made to congress by the U. S. Corps of Engineers in 1891 (Ex. Doc. 267, p. 86) the gravel remaining in the Sacramento Basin and workable under the old conditions (i.e., without restrictions as to dumping the debris) was estimated as 518,725,000 cubic yards; and a much larger amount if long tunnels and ditches were constructed to give access to ground not yet available—viz. 1,508,875,000 cubic yards, which is more than the amount already washed.

* * *

"Justification for a Dam for each River in Turn.

"Considering each river separately we have at least one large gravel deposit which if proven to be profitable under the proposed conditions of resuscitation would by itself justify the erection of a dam so large that it would also serve other mines on that river. Judged in this way we may say that a dam that would serve the principal deposit for 20 years would serve all deposits on that river for 15 years, or something of this order, each case having to be worked out according to the deposits and the conditions.

"This method of treatment has been followed, the "key" deposit on each river receiving most attention. It has been impossible to obtain data required for the smaller mines or portions of gravels to enable reasonably close estimates to be made, but approximate yardages were calculated for ground favorably situated so that no mechanical difficulties would prevent it from being worked. The ground considered to be payable has been restricted to ground that would be readily worked."

A letter to Mr. Jarman (p. 35) from the Yuba River Power Company contains the following statement relative to the proposed dam at the Narrows:

"At present, our preliminary cost estimates on the Narrows unit have been made without actually drilling the dam site, nor have final figures been worked out as to revenues from power and irrigation and debris storage space, but preliminary estimates indicate that we can sell outright the 350,000,000 cubic yards of debris storage space for $1,500,000. This quantity is the actual cubical contents of debris storage space estimated to be available at the Narrows unit with a dam having its crest at elevation 520 feet above mean sea level."

A statement prepared by the California Debris Commission and transmitted to Mr. Lloyd L. Root, State Mineralogist, is included by Jarman (p. 37), in which is the following tabulation:

"Following are preliminary estimates made up from data available at this time. The storage estimates are based on those considered necessary or desirable for 20 and 10 year periods of mining operations respectively * * *.

"Twenty Year Period.

River	*Site*	*Storage, cu. yds.*	*Cost*
Middle Yuba	Freemans	51,000,000	$1,150,000
South Yuba	Nortons	70,000,000	3,090,000
South Yuba	Jones Bar	20,000,000	745,000
Bear	Lower Bear	21,000,000	310,000
North Fork American	Owl Creek	41,000,000	935,000
Middle Fork American	Mammoth Bar	22,000,000	125,000
Totals		225,000,000	$6,355,000"

The above figures give approximate costs per cubic yard storage, of 2 cents, 4–, 3, 1½, 2, ½ cents, respectively, for the several dams indicated.

Jarman (p. 44) referring to prices quoted by Ross E. Browne and R. W. Raymond as being paid by hydraulic miners for water, remarks:

> "It does not seem likely that old-time miners were washing *5-cent* gravel with such expensive water, even though the surface gravel at Gold Run had the reputation of being very easy to wash."

Mention has already been made herein to the study on hydraulic mining made by the Mineral Resources Section of the Commonwealth Club of California in the period, August 1927–April 1928. From the minutes of those meetings, the following data are drawn, from the statements of engineers who spoke from first-hand knowledge and experience in gold-gravel operations.

Mr. Roy H. Elliott, mining engineer (meeting of August 24, 1927), prefaced his presentation of the figures following, with this appraisal of the "Jarman Report."

> "This report by Mr. Jarman, I recommend for your study as an able, and in my opinion, very conservative statement of the situation as it now stands.

"Estimate of Gravel Yardages and Values

Stream or watershed	*Total yardage available*	*Probable mineable in 20 yrs.*	*Est. yield*
North Fork American	115,000,000	23,000,000	$2,640,000
Middle Fork American	30,000,000	13,000,000	1,347,000
Bear	43,000,000	26,500,000	4,167,000
South Yuba	415,000,000	105,400,000	14,800,000
Middle Yuba	450,000,000	100,000,000	10,500,000
Totals	1,053,000,000	267,900,000	$33,454,000

> "The figures given by Mr. Jarman for the South and Middle Yuba Rivers have been amended here to include more of the San Juan Ridge gravels. The North Yuba is not taken into account, as its storage necessities are already provided for by the Bullard's Bar Reservoir. If the Narrows dam is built, it will take care of both the South and Middle Yuba River drainages, and will do away with the necessity of the Jones' Bar dam or others on the South Yuba, except possibly at a much later development to prolong an industry then in full swing. It seems probable that this should be the case, and that the number of years of operation, particularly in the Yuba Basin, can be extended much beyond the 20-year period above mentioned."

Referring to suggestions made for recovery of gold by drift mining he said that although the gold is generally concentrated on or near bedrock,

> "it is a general condition in these large deposits, and especially those of the San Juan Ridge, that the gold is pretty well distributed through the gravel for many feet above bedrock. On the San Juan Ridge about 150,000,000 cubic yards of surface gravels lying 200 to 400 feet above bedrock, produced from three to five cents per yard. The average gold content has been shown too low to stand the cost of underground mining methods."

In the discussion concerning values and costs following Mr. Elliott's paper, Mr. Otto von Geldern, engineer for the farmers of the Sutter Basin, quoting the figure of 10 cents per cubic yard from W. W. Waggoner of Nevada City (see "Jarman Report" pp. 74 and 77), asserted that costs are now greater. It was later pointed out that:

"Waggoner's estimate of 10¢ per cubic yard included large bodies of very low-grade gravels which are not included in Mr. Arthur Jarman's estimate of 'available' under present conditions. This would give a higher average value that would assuredly be economically profitable to work."

Mr. Elliot added that

"based on recent studies, with all data available including drilling results, there are about 400,000,000 cubic yards in San Juan Channel of 10.5 cents recovery value. Mining costs are estimated at 6¢ including storage costs as now estimated."

Mr. Pierre Bouery, former manager of the La Grange hydraulic mine in Trinity County, stated he

"had mined 65,000,000 cubic yards valued at 5 cents per cubic yard at a profit of 2 cents per cubic yard when no debris law was applied and he did not see why when gravel was worth 10 cents per cubic yard it could not be worked at a profit with an added charge of 2 cents to 3 cents for impounding, if the essentials, water, values and dump were found."

Mr. James D. Stewart, mining engineer, Auburn, stated that

"he and his father washed gravel at Iowa Hill with a recover of seven-eighths of a cent per cubic yard and made it pay expenses; and that at Gold Run they washed 237,000 cubic yards with a recovery of $84,000." (36¢ per cubic yard).

Under "Discussion" (meeting of Sept. 7, 1927), Mr. Elliott pointed out that the 7-cent cost referred to by Mr. Noyes (State Assemblyman from Marysville) has been superseded by later figures and studies by Mr. C. H. Munro (for River Mines Co., and an operator with some years' experience hydraulicking, particularly in Alaska), and that the cost per cubic yard is assumed to not now exceed 6¢.

"The arbitrary addition of 66 2/3 per cent to the old costs is not justified on large-scale operations."

Mr. James D. Stewart (meeting of Nov. 2/27) showed

"that the gravels of the Yubas, the Bear and the American watershed can be worked profitably by the hydraulic process and their debris stored so that it will not menace the lands of streams below"; also cited one deposit of "some 90,000,000 yards of this gravel (exhibiting a specimen, gold-bearing) remaining with a depth of 200 feet. The top gravel paid 15 cents per yard, but most of this had been worked leaving the richer bottom gravels." Answering a question as to "how much hydraulic miners could afford to pay for storage," he stated that "3 cents per yard should be the limit;" that "gravel that could not afford to stand a 3-cent charge should not be worked." Relative to a suggestion that the mine owners interested should cooperate in the building of dams, Mr. Stewart replied that "ownerships being so scattered it would be impossible to get the owners together."

Under "Discussion" (meeting of Nov. 30/27), following address by Assemblyman Harold C. Cloudman, author of the bill which provided for the "Jarman Report," Mr. Stewart referring to storage charges stated:

"Generally 1½ cents to 2 cents per cubic yard is a fair charge. There are some gravels that should be worked that could stand only 1 cent and others as much as 5 cents. Where top material is worked the charge should be at least 50% higher." Answering a question as to gravels from which the overburden has already been removed, Mr. Stewart stated that

"at Gold Run the deposits had averaged from 350 to 500 feet in depth, that some 200,000 yards of top material had been stripped off leaving the bottom material running from 80 to 270 feet in depth and from 15 to 20 cents per yard in value."

Mr. Elliott thought that

"Mr. Stewart was correct regarding charge for storage that gravel could pay. On the San Juan Ridge where the gravel ran from 10 to 10½ cents it could afford to pay 1 cent for storage. If the storage at the Narrows Dam is as large as figured

> on, a one-cent charge would be enough. Storage charges on each stream, should vary with the cost of providing it, * * * In regard to the low-grade top material, leaving out the North Bloomfield pit, over 60% of the mineable area has been stripped down to clean gravel."

In answer to Col. Jackson's question if "he figured that storage could be had at the Narrows dam for 1 cent per cubic yard," Mr. Elliott answered that "if power development could be made to stand part of the cost, yes; otherwise, no."

Under "Discussion" (meeting of Dec. 28/27), referring to plan for dam at Narrows, by private capital, Mr. Elliott stated:

> "The Narrows dam would probably have been built several years ago if the Federal Power Act had not upset all logical plans for the development of the North Yuba River."

Mr. Elliott, in a paper (dated Jan. 11, 1928) submitted at the meeting of January 20, 1928, commenting on papers of Von Geldern, et al.:

> "The average cost per cubic yard at the North Bloomfield mine from 1870 to 1884, while mining nearly 8,000,000 yards was 4.27 cents, the operating profit was 4.79 cents."

Though he agrees with Von Geldern that some cost items may have increased meanwhile (but not to the extent of "67 per cent"), he further comments:

> "*But,* he (Von Geldern) does not give credit for advances in the technique of hydraulic mining as in all other industries, or for the benefits to be had from a consolidation of these various mines under one management, or for the use of the available water more efficiently. Large production and efficient management can reduce costs in hydraulic mining as well as in the automotive industry or others that could be mentioned.
>
> "The water actually available for mining on the San Juan Ridge by the construction of a modern steel flume from lower down on the Middle Yuba River than any previous diversion of water for these mines is more than it was at any time during the old days. Moreover, instead of being scattered for use in 8 or 10 mines under separate ownership and management, it will be concentrated for best use in one or two pits. This will certainly tend to increase its effective use. Also, instead of using portions of this water to operate derricks, compressors, and so forth, cheap electric power is now available, releasing all water for use under pressure for mining." Cites use of manganese steel riffles as one instance of an improvement which has cut costs.
>
> "Taking all these facts into consideration it works out that there will be a decrease in the labor cost per cubic yard mined instead of a 67% increase, and the increased duty of the water will largely overcome any increase due to higher costs of supplies.
>
> "In short, we contend that the mining of this particular deposit can be carried on at approximately the same cost as in 1884. Of course the charge for storage will have to be added, bringing the total operating cost possibly up to 6¢ per yard."

Jarman in writing (under date of Jan. 2/28) to the Mineral Resources Section chairman submitted comments on Von Geldern's statement. He supports Pierre Bouery's statement that Columbia Hill and North Bloomfield

> "should be mined at a cost of 5 or 6 cents per cubic yard. * * * Mr. C. H. Munro who mined 40,000,000 cubic yards of frozen gravel in Alaska by hydraulic mining, obtained a duty of 5.1 cubic yards per miner's inch. Mr. Bouery obtained a duty of 5.34 cubic yards. In each case, the work attracted much attention as being efficient, and was noted as such in mining journals in various countries. When both these eminent hydraulic miners tell us their costs would be between 5 and 6 cents per cubic yard we know they are not spinning any fairy tales. If, instead of accepting Von Geldern's 67% cost increase to 7.55 cents per cubic yard, we apply the duty of 5 cubic yards instead of 3.77 cubic yards obtained at North Bloomfield, we have computed costs reduced as follows:
>
> $7.55 \times \frac{3.77}{5.00} = 5.68$ cents, which is close to Mr. Munro's estimate of 5.15 cents.
>
> "In the same way, I am satisfied that Mr. Stewart will be able to wash 3 cubic yards per miner's inch at Gold Run, by adopting modern methods of breaking the bank of cemented bottom gravel, instead of following the old methods. The former duty was 2."

James D. Stewart, also in a letter to the chairman, dated Jan. 23/28, says:

"As to the values in the gravels for which the dams are to be built and whether they can be profitably worked or not this question can be dragged out endlessly.

* * *

"The hydraulic miner does not want charity nor does he want to build dams to hold his debris and at the same time have it filled by the debris from other classes of mining as well as debris washed from government lands for which he does not receive one penny."

Frank H. Probert, Dean, College of Mining, University of California, in a letter dated Mar. 6, 1928, commenting (meeting of Mar. 7) on gold production of California 1853–1883 from hydraulic mining says:

"Computing from Lindgren's estimate it appears that the 1,295,000,000 cubic yards of gravel washed yielded 23.2 cents per yard. Jarman predicts as total operations covering 20 years after completion of proposed dams, 201,932,000 cubic yards of gravel being washed yielding $23,454,000 or average 11.6 cents per yard."

* * *

"The records of the N. Bloomfield mine for the decade 1875–1884 showing 9.81 cents per yard and C. H. Munro's estimate of value on the San Juan channel of 10.3 cents lend weight to Jarman's predictions, all other things being favorable."

Mr. Munro (Mar. 14) commenting on Dean Probert's citation of cost figures:

"A fair figure would be the North Bloomfield records from 1870 to 1884, which show 29,870,000 cubic yards mined at a cost of 4.27 cents, * * * The La Grange records from 1905 to 1913 show that 25,107,200 cubic yards mined, recovery value 5.6 cents per cubic yard, working cost 2.8 cents, operating profit 2.8 cents, duty per miner's inch 4.45 cubic yards. This is representative of the present day costs * * *. (p. 3.)

"Three years have been devoted almost exclusively to the recent study of placer deposits on the San Juan Ridge, in Nevada County, applying the knowledge obtained through the placer mining regions of the world and working out a comprehensive plan for the hydraulicking of this deposit. The mining of deposits of this nature has convinced me that it will return the capital expenditure, together with sufficient margin of profit to interest private capital in the enterprise. Whether 100,000,000 or 200,000,000 yards are mined depends largely on the storage space available for tailings.

"While I am confining my remarks exclusively to the San Juan placer property on the Yuba, still in a general way conditions are quite similar on the properties tributary to the Bear and the Forks of the American River.

"*Yardage and valuation*—Contents placer deposit approximately 900,000,000 cubic yard gravel.

"It was originally proposed to mine 408,000,000 yds. with an average recovery of 10.3 cents per cubic yard, or a gross value of $42,000,000. A revaluation was again made to come within the limits of the storage space available for impounding tailings. This gave a total of 200,000,000 yards with an average recovery of 12 cents per cubic yard or a gross value of $24,000,000. The valuation is based on the mining records from one mile of channel from surface to bedrock on the east and one-half mile on the west end, supplemented by almost three miles of prospect drilling. The 200,000,000 yards has been selected near the western end on the area prospected with drills.

"Mr. Probert has felt some concern over the average gold content. Any company taking up the property would want to do a small amount of additional prospecting, but for the present it is unnecessary. Of the 1,050,000,000 cubic yards originally in the deposit 150,000,000 cubic yards has been mined or over 14 per cent of the total. *This in itself is a sizeable sample.* (Italics are all ours—W. W. B.) Add to it the supplemental drill holes and shafts, covering an expenditure of $100,000 and any placer engineer familiar with valuing large deposits of this nature would, I believe, agree that only a small amount of additional prospecting is necessary. * * * Thousands of dollars have been spent on detailed surveys for tunnel sites to establish sluice grades. * * * Valuable engineering data have been accumulated over a period of 68 years. * * *

"Another important consideration is that from 100 to 200 feet of the surface containing the fine gravels and sands have already been mined from the area it is proposed to work, leaving 200 to 500 feet of the coarser gravels and sands that can be easily retained in the impounding dams. * * *"

Enumerates improvements in modern or later-day practice:

"*Mining Costs.*

"In the few calculations where it has been necessary to compare past and present-day labor, I have allowed an increase in labor cost of a little over 100%. The modern methods of operating with innovations and improvements in equipment materially reduce the labor required and increase the duty per miner's inch. These factors with many others make it feasible to operate hydraulic mines at a lower cost today than 40 years ago.

"In the cost of mining I have included the following items:

Labor,
Ditches maintenance
Cost of Water
Materials and Supplies
Explosives
General expense & Management

making a total cost of 3.75 cents per cubic yard. The charge for impounding tailings in the dam will have to be added to this cost. But this will not be a prohibitive item for the total cost of a dam will not be charged against the mine tailings storage space, as revenue will be derived from power and irrigation. Where storage space allotments are made, a charge of ½ cent to 1 cent per cubic yard, depending on the quantity, has been suggested.

"* * * Analyzing the various items contributing towards cheaper working costs, the item of a duty of 5 yards to a miner's inch is considered conservative.

"The recovery has been placed at 12 cents per cubic yard leaving an operating profit of from 7.25 cents to 7.75 cents per cubic yard. Assuming that the property has a life of 20 years, this will amply provide for a sinking fund to cover capital expenditure and provide satisfactory dividends. * * *

Photo by Walter W. Bradley.

Bullard's Bar Dam on the North Fork of Yuba River.

"Another feature which will be of interest to power companies and irrigationists is the fact that when the mining is completed the hydraulic pits may be used for the storage of 100,000 acre feet of run-off water per year at an elevation of 700 feet above the Yuba River. These pits will be filled from the new mining ditches during the winter and spring run-off and will be available for power and irrigation when needed. This is an advantage over storing water in reservoirs on the main river systems for the natural waste from the watersheds over a long period of time will eventually fill the reservoirs in the river beds."

Under "Discussion" (meeting of Mar. 7/28) Arthur Jarman answering the criticism that Bullard's Bar dam was not being utilized as it might be by the miners, stated that

"three-quarters of the impounding capacity of Bullard's Bar dam has been sold and the delay in mining was due to the necessity of getting the water supply matters cleared."

There is a striking unanimity in the thread of thought noticeably running through practically all of the foregoing quotations that the best and most dependable evidence of gold values in these Sierran gravel channels is the record of past performance. It is not a simple matter, nor quite practicable, nor yet necessary to the purposes or soundness of the currently discussed report, to sample in detail each of the gravel deposits within the areas involved. It has not been the general practice in this branch of placer mining to sample in as great detail before beginning excavations as for example, in the case of ground to be dredged, nor is it possible in most cases to do so. It is distinctly and manifestly unfair to disregard the evidence of past performance. As Mr. Munro said in one of the above quotations, concerning the San Juan Ridge deposit, ''14% washed from 1,050,000,000 cubic yards is a sizable sample.'' A number of prominent, large and paying hydraulic mines were stopped in 1884, not for lack of gold to make the operations profitable, but by injunctions and the Sawyer Decision. In effect, the ''Jackson Report,'' practically says any remaining gold claimed, disappeared with the serving of the injunctions; and because the members of the commission did not see with their own eyes the gold recorded as having been washed out, ''there ain't no such animal.''

We repeat that, in the light of the experience and judgment of engineers and operators versed in this type of gold mining, detailed sampling is not needed to enable a decision to be made on the question of location and size of the debris dams. The rule of the courts as to the sufficiency of a mineral discovery to warrant a valid mining location on the public domain, to the effect that ''The discovery should be such as to justify a man of ordinary prudence not necessarily a skilled miner, in the expenditure of his time and money in the development of the property'' (A. H. Ricketts, ''American Mining Law,''; Cal. State Division of Mines, Bull. 98, p. 343, Note 19, 1931) is a rule that could well be observed in the present subject.

Mr. James D. Stewart, one of our best known and persistent hydraulic miners in California, commenting on the conclusions of the Debris Commission, in a letter to the undersigned under date of February 18, 1935, says:

> "First of all, the persistent defiance of Court injunctions and Federal laws covering this matter is proof of the values and profits. It was necessary for Congress to write into the Caminetti Act a five-year penal clause and a five-thousand dollar fine or both for the operation of a hydraulic mine without Federal License on the Sacramento or San Joaquin watershed. Even this was defied.
>
> "Personally the writer defied it intermittently and for eleven years on one property without a break. *Men do not do these things unless there is profit.*" (The italics are ours—W. W. B.)

Comparison of the figures of yardage for which to provide storage in the several dams, as shown in the tabulations given by the ''Jarman Report,'' by R. H. Elliott (Commonwealth Club study), and by the ''Jackson Report,'' indicates the last named has not included all of the gravels considered ''available'' by the miners. This at once accounts for the Debris Commission's higher dam construction and amortization costs of 4+ cents per cubic yard, against the others' 1¢ to 3¢ per yard. This has an important bearing on operating costs and probable profits.

Also, it should be borne in mind that the calculations of the Jarman and earlier reports are based upon gold at $20.67 per fine ounce. If a profitable operation could be figured at that price, how much more certain is it at the present $35 per ounce!

That the undersigned is not alone in his appraisal of the sufficiency of the foregoing reports and data for the purposes of the current proposition for dam construction, I quote herewith the comments made verbally to the writer by Mr. T. J. Hoover, Dean of Engineering of Stanford University and a mining engineer of international experience, on the conclusions given in the ''Public Notice'' of Feb. 13, 1935, from the California Debris Commission:

> "(1) There is plenty of information available to accurately determine the gold content of the gravels, for a report of this sort. Source: State Division of Mines or the private reports of old hydraulic companies.
>
> "(2) There would certainly be need for federal cooperation if permission is to be granted for the construction of storage dams.
>
> "(3) If there is not enough gold to pay for a federal enterprise by the same reasoning there would not be enough for a private enterprise.
>
> "(4) The old hydraulic mines in the San Juan district were making lots of money when they were ordered to stop in the middle of their work, by the Caminetti Act. Now the price of gold is advanced and the gravels are still there.
>
> "(5) The greatest problem lies in the *water rights* and this should be easier handled by the government than by private concerns. Without water rights nothing can be done about mining the gravels.
>
> "(6) If the Federal government has any business in any sort of enterprise, this would be one place where it could do the most general good."

We submit that their judgment of the sufficiency of the value data available for the purposes of the current proposition, as shown by such mining engineers as A. H. Jarman, Roy H. Elliott, James D. Stewart, C. H. Munro, John Hays Hammond, T. J. Hoover, Chas. S. Haley, Pierre Bouery, as quoted above, should by reason of their special training and experience relating to gold-bearing gravel deposits, be given greater credence and weight than the opinions of men trained in other branches of engineering however high their rating therein.

Respectfully submitted.

WALTER W. BRADLEY,
State Mineralogist.

San Francisco, Cal., March 25, 1935.

LEASING SYSTEM AS APPLIED TO METAL MINING [1]

By W. O. Vanderburg [2]

INTRODUCTION

The leasing or tribute system has been an important factor in the development of our metal-mining industry, particularly in the gold and silver mines of the Western States. It has received its widest application in the early history of many camps and in the last stages of many mines. The system is especially adapted to mining where the ores occur in narrow veins or are erratically distributed in small bunches or pockets so that selective mining, hand sorting, screening, or hand cobbing is required to produce shipping or milling-grade ore. The leasing system is also applicable to the development of prospects where the owners are unable or unwilling to assume the risks of searching for ore.

The virtue of the system lies in the opportunity it affords miners with little capital to get started; at the same time, it gives owners an opportunity to have their property developed at small cost.

In the following pages leasing is defined; a brief history of the system is given; its advantages and disadvantages discussed; and as an aid in drawing up a lease the terms ordinarily included are set forth. In regard to the terms of a lease the statements should be taken as illustrative rather than applying exactly to average operating conditions. In the final analysis, just how the details of the leasing system can be applied to a property is a problem which must be worked out in each case.

DEFINITION OF LEASING

The term ''lease'' as ordinarily used in metal mining is a written or verbal contract for the exclusive possession and use of real property with specified restrictions, for a definite time, and for a stated consideration called rent, royalty, or tribute, payable at fixed times with money, in part of the product, or an agreed percentage of the proceeds derived from the sale of the mineral. The last-mentioned method of payment is the one commonly employed in the United States. The party taking the lease is variously called a grantee, lessee, tributor, adventurer, or chlorider.

According to Lindley [3] mineral in place is land and an estate in such mineral may exist as an entity entirely separate from the overlying surface. Removal of minerals from the land is an act which constitutes permanent destruction of real estate. Unlike a business lease the relation of landlord and tenant in a mining lease does not contemplate destruction of the estate, and such destruction can not be called use. Therefore, while the contract is in name a lease it amounts to a sale and the so-called royalty is purchase money for real estate.

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[1] "Reprinted from U. S. Bureau of Mines Information Circular 6774."

[2] Associate mining engineer, U. S. Bureau of Mines.

[3] Lindley, Curtis H., Lindley on Mines: 3d ed., vol. 3, 1914, pp. 2135–2138.

The California courts have held that a contract giving the right to work a mine for a certain time (the gross profit to be divided between the parties) is not a lease; that such contract does not create the relation of landlord and tenant but fixes a rule of compensation for services rendered, and that in all its essentials it is a contract of labor to be performed and paid for by a share of the profits.[1]

According to this interpretation leasing may be defined as a pro rata method of paying miners' wages. It differs from the contract system of paying wages used at some mines, by making the miner a sharer in the risk as well as in the profit.

Although it may be difficult to determine the correct legal name for the contract employed, this is less important from a practical viewpoint than ascertaining from the contract the respective rights of the contracting parties.

In some states a verbal lease on mining property is as binding as a written one, which is contrary to the general law that any transfer in the interest of land shall be void unless in writing. However, it is best for the protection of both parties that a mining lease be in writing and properly recorded.

Lessees are not always individuals but may consist of a number of men associated as a company for the specific purpose of leasing.

Leases are not confined to mines proper and prospects but may also include mine dumps, mill tailings, or mills, which contain recoverable minerals.

BOND AND LEASE

The term ''bond and lease'' as applied to mining is commonly used to cover a contract whereby the owner of the property agrees to sell it at a stated price and deliver a valid deed for it before the lease expires. A bond and lease provides for the possession and working of the property by the lessee, usually with the right to appropriate the mineral, with payment of stipulated royalty on the ore extracted. It usually gives the lessee ample time in which to determine the merits of the property, and in the event of disappointment in its worth, he may terminate the contract. Since the value of mineral land with little or no ore in sight is extremely difficult to determine, a bond and lease on a property furnishes the lessee an incentive to do exploration and development work to demonstrate the value of the property before purchase.

HISTORICAL DEVELOPMENT OF THE LEASING SYSTEM

The evolution of the leasing system is historically interesting, since it has played a prominent part in the development of mining from remote times.

In ancient Greece the mines were considered the property of the state and were worked by lessees who paid tribute to the state either in the form of initial purchase or annual rent. This conception of mineral-land ownership was inherited from older civilizations.

Under Roman law, likewise, the mines obtained by conquest belonged to the state, which leased them to operators or worked them directly with slave labor.

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[1] Mining and Scientific Press, vol. 89, 1904, p. 3.

Before the 13th century the miner or landlord had few rights to minerals, but with the rise of individualism about this time a number of charters appeared in Europe and England which confirmed to mining communities certain privileges but all reserved the regalian right whereby some minerals, particularly gold and silver, could be mined only on payment of royalty to the crown.

In England the mining communities of Cornwall and Devon were in the 13th century chartered into corporations called the ''Stannaries,'' with broad powers but with the reservation to the crown of some sort of royalty. Eventually the miners and landlords obtained greater rights at the expense of the crown, and gradually the leasing system under private control came into existence.

The basic features of the leasing system in the United States probably were derived from England. The policy of leasing mineral lands in the United States by the federal government was inaugurated under act of Congress March 3, 1807, wherein lead mineral lands in the Indiana territory (Louisiana Purchase) were removed from sale, with the provision that they should be leased on an annual rental. The leases were under the supervision of the War Department. Royalty of one-eighth to one-tenth payable in lead or cash was demanded. The act provoked opposition, so that President Polk, in his first message to Congress, December, 1845, recommended its repeal. This first attempt at leasing mineral lands by the federal government was abolished in 1846.

Although the leasing of mineral lands by the government proved unsatisfactory in the early days the system, under corporate or individual control, gave a tremendous impetus to metal mining in the West. The leasing system was introduced into the mining camps of the West in 1859 in the Gregory district, Gilpin County, Colo. It spread rapidly to other western states, and attained its greatest development in Colorado and Nevada.

Among the districts where leasing has been a prominent feature in the operation of mines may be mentioned Cripple Creek, Aspen, Leadville, in Colorado; and Eureka, Tonopah, Goldfield, in Nevada. Numerous other mining camps could be cited where leasing has been employed at some time in their history, but the above will indicate that the system has been an important link in the chain which forms the stage-by-stage establishment of commercial mining risks, and also a noteworthy feature in working old mines where individual miners take chances of making money under conditions which do not appeal to companies.

ADVANTAGES AND DISADVANTAGES OF LEASING SYSTEM

The leasing system is particularly applicable in working old mines where the ore deposits are small and occur eratically and the finding of ore is the principal difficulty; or where the ore occurs in narrow veins, or bunches, which must be mined carefully and concentrated by hand to produce a shipping or milling grade product. In these cases the leasing system offers advantages compared to company operations on a days-pay basis.

A lessee has a sense of personal possession in part of the mine, and his primary aim is to make his lease as productive as possible. This sense of ownership provides a strong mental stimulus and brings forth intensified effort, since the lessee realizes that his success depends on his own skill and labor. By financial participation in the results of personal effort the lessee is also willing to take financial risks that the company may not be willing to advise, in the hope of making a strike, and by so doing he is occasionally rewarded with success.

The lessee generally works with a minimum of capital and consequently divests his working costs of every unessential item. He is primarily interested in profits with the least possible expense, and in this he is generally more successful than some companies which install costly plant equipment before enough ore has been found to justify the expense.

An important feature of the leasing system from the viewpoint of community prosperity is due to the fact that the lessee is frequently "grubstaked" by local residents, and any success attained leads the way to further effort.

Formerly it was considered at least a tacit admission that the end of a mine was in sight when it was thrown open to lessees. In recent years, however, some large mining companies have employed leasing as an adjunct to their regular operations. As an example, the El Tigre mine in Sonora, Mexico, producing gold and silver, was forced to make drastic reductions in wages and personnel in 1931, due to falling silver prices. Continued operation was made possible by resorting to the leasing system.[1]

Where leasing is conducted under the general supervision of the management and where care is exercised in the selection of well-qualified men the system works out more satisfactorily than the old method when the lessees were left to their own devices. In the latter event only the best ore was gouged out, the workings left in poor shape for future operations, and any low-grade ore left behind could be mined only at considerable expense.

In many mines there is a time when at least part of the territory can be worked to better advantage by lessees than by any other method. The two principal reasons are: First, the lack of efficiency and the expense of supervision for small operations distant from the larger stopes; and second the close attention required in hunting and mining small bunches or stringers of ore frequently overlooked or left behind intentionally in the rapid mining of large ore bodies.

An advantage of the leasing system from the property owner's viewpoint is that the lessee is responsible to the owner for damage to the mine, while under the days-pay system the owner is responsible to his employees. Also, the mine owner is not liable for liens when his property is worked by lessees.

The leasing system has been condemned because the contention is made that development work is apt to be done grudgingly and with little attention to subsequent utility. To this objection it may be stated that if adequate supervision is maintained over the lessees' work there is little reason why it will not come up to company standard.

The argument is also made that the lessee can afford to mine only high grade ore, leaving the lower grade material that by itself can not be mined at a profit. This objection can be remedied by proper adjustment of royalty payments on the lower grade ores.

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[1] Wasley, W. A., The Mexican Gambusino in El Tigre: Min. and Met. April, 1933, p. 187.

TERMS OF A LEASE

There is no standard form of a lease suitable for all mines. The terms of a lease are varied to suit the conditions at each mine or the ideas of the owner and lessee. The elements of a lease may be summarized as follows:

1. Date; names of contracting parties.

2. Duration of lease; date of beginning, date of expiration, and whether or not subject to renewal.

3. Description of lease; location and name of property; description of leased ground by definite boundaries.

4. Royalty; amount of royalties and how calculated; when and how paid.

5. Manner of working lease.
    - *a* Minimum number of working shifts required per month by lessor.
    - *b* What constitutes abandonment and forfeiture of lease.
    - *c* Ownership of plant and improvements made by lessee when lease is terminated.
    - *d* Safety of premises.
    - *e* Disposal of waste.
    - *f* Preservation of adjacent parts of mine, keeping levels clear, timbering and repairs, stoping near shaft.
    - *g* Minimum dimensions of underground workings, namely, shafts, winzes and raises, drifts and crosscuts.
    - *h* Underhand stoping, whether or not permitted.
    - *i* Work subject to inspection and direction of company agent.
    - *j* Where ore is to be milled or smelted.
    - *k* Bills incurred by lessee to be settled promptly and vouchers to be shown lessor on demand.
    - *l* Subleasing, whether or not permitted.
    - *m* Ownership of dumps when lease is surrendered.
    - *n* Weighing and sampling ore.
    - *o* Liability for damages or indebtedness.
    - *p* Charges for compressed air, hoisting, transportation, blacksmithing, or other equipment and services furnishes by lessor.

The principal points of difference in lease contracts are duration of lease, size of leased ground, and royalties.

The duration of the lease is nearly always specified, and it may range from 6 months to several years. Leases covering precious metal mines and prospects usually are given for 1 year, sometimes with the privilege of renewal for another year. Occasionally a lease may be of indefinite duration, but the lessee's operations are confined to a restricted block of ground.

Any equitable and practical leasing system must recognize that the discovery of ore involves an expenditure of time and labor so that the lessee must be adequately protected in his contract after a discovery is made. There is rarely any objection by the lessor to have the work continued as long as the lease remains unproductive. Difficulty sometimes arises, however, when the value of the lease is demonstrated. As a suggestion a good way to deal with such a contingency would be to date the lease from the time of the first shipment of ore.

There is considerable variation in the size of the blocks of ground granted to lessees. Old mines worked on the leasing system may be divided into a number of blocks, which are worked by different sets of lessees. The size of the blocks may be 100 feet along the strike of the vein and the height between two levels or the entire block of ground between two successive levels. Sometimes the lessors reserve the right to work blocks of ground immediately above or below any new finds made by the lessees in their explorations.

An entire mine or prospect, including all the surface and underground equipment, may be leased. If the mine or prospect is not equipped with machinery the lessee usually is required to furnish it. A fair medium between this arrangement and one where the lessor furnishes the equipment may be arranged whereby each party furnishes part of the equipment.

BASES OF SETTLEMENT (ROYALTIES)

In the leasing system the royalty represents the division of the profit on the ore produced. It is to the advantage of both parties to the contract to make an equitable adjustment of royalty payments. High royalties put a premium on gouging for higher grade ores and decreases the lessees incentive to do exploration work.

There never has been any attempt at standardization of royalty payments, as the problem involves not only variation of the metal content of ores but also variable costs of mining, treatment, and transportation. In consequence, royalties must be adjusted to suit the conditions at each property. In general, three methods are employed in settling royalties in mine leasing. These are flat royalty, split-check, and sliding-scale methods of payment.

With the flat royalty method of payment the royalty to be paid is determined largely on the amount of ore available and the difficulties of exploration or development. Royalties may be 5 to 30 per cent of the assay value of the ore or of the net returns from the mill or smelter. The higher royalties usually indicate that high-grade ore exists under favorable conditions for mining, while the lower royalties indicate the reverse. Conditions are so variable in different mines that no general rules can be applied in fixing royalties.

As an illustration of the flat scale method of royalty payments the Goldfield district, Nevada, may be cited. This district owed its rapid expansion in its initial stages of development almost entirely to the leasing system, and with the exception of the Combination mine virtually all of the ore bodies were discovered by lessees. The early leases in the district generally ran for 1 year, and the royalties ranged from 20 to 30 per cent of the returns from the smelter. So rich were many of the ore bodies that numbers of successful lessees made fortunes in a few weeks. The original Florence lease produced $750,000; the Bowes and Kernick lease on the Jumbo property, $500,000; the Reilly lease on the Florence No. 2, $550,000; and the Hayes and Monette lease, a gross total of $4,400,000.

The silver-gold deposits of the Tonopah district were also prospected and developed in the early years by leases let on a flat scale basis. To prove the value of the original discovery in this district, Jim Butler, the discoverer, gave a number of leases with a flat royalty of 25 per cent based on the smelter returns. These leases ran 1 year, and many were very profitable. Ore valued at $4,000,000 was extracted by lessees before the leases expired. It is interesting to note that all the leases given by Butler were verbal, and even though the property was sold while a number of them were still in effect, the verbal contracts made were observed to the letter.

With the split-check system of leasing the net returns from the mill or smelter are divided equally between the lessee and the lessor. In this arrangement the lessor furnishes the equipment for mining, explosives, and all other supplies necessary, while the lessee furnishes the labor and supervision. By the split-check system the lessees are able to do more prospecting and development work than is possible with other methods of royalty payment since there is closer cooperation between lessee and lessor.

The split-check system is employed extensively in subleasing where a lessee may take a lease on an entire mine on a flat royalty basis and sublease blocks of ground to smaller operators. The original lessee usually provides all the equipment and supplies, so that the sublessee risks only his time and labor. Many experienced lessees prefer the subleasing arrangement, even though it entails higher royalty, because they prefer to work with machine drills rather than hand steel or other less efficient equipment.

An example of the split-check system of royalty payments practiced in the Cripple Creek district is described by Keeler.[1] The Engineers Lease, Inc., organized by a group of engineers, obtained leases in the Vindicator, Cresson, and Portland mines of the Cripple Creek district, on royalty terms whereby the returns from the mill were divided equally between the lessee and the lessor. Supplies and equipment were furnished by the companies, and the Engineers Lease furnished all the labor, management, and engineering skill. The split-check principle was carried farther in the division of the profits accruing to the Engineers Lease: two-fifths of the profit is paid to the miners, who in addition were guaranteed a ''grubstake'' wage of $1.25 per day, two-fifths is paid to the men furnishing the capital for paying the miners, and one-fifth goes to the organizers of the plan.

In the sliding-scale system of royalty payments the royalties are low on the lower-grade ores and become higher with increasing value of the ore. The justification for fixing a ratio between the value of the ore and the royalty is that the lessee can better bear the higher royalty on the higher-grade ore. Were no sliding scale adopted and all ores, irrespective of grade, charged at an average royalty, that royalty would be so high as to make the production of lower-grade ores unprofitable to the lessee. Hence, a low royalty on low-grade ores stimulates mining this class of ore. An illustration of sliding-scale royalty payments is as follows:

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[1] Keeler, Ralph, Unique Unemployment Relief, Min. Jour., vol. 15, no. 21, 1932, p. 6.

Value of ore per ton	*Royalty payment per cent*
Up to $10	10
$10 to $20	15
$20 to $40	20
$40 to $100	25
$100 to $240	30
$240 and over	50

With the sliding-scale system, royalties vary greatly in different mines. The system is particularly applicable where there is considerable variation in the metal content of the ores. As high as 95 per cent royalty has been paid by a lessee on exceptionally rich ore, and the lessee was still able to make a profit.

A variation of sliding-scale royalty has been employed whereby the percentage of the gross value of the ore is determined by taking a fractional part of the value of the ore. Thus, if the fraction decided upon is one-third and the ore assayed $60 per ton, the royalty would be one-third of 60 or 20 per cent, equivalent to $12 per ton. Obviously, if the ore assayed $300 per ton the royalty would be one-third of 300 or 100 per cent, the entire value of the ore. To avoid this difficulty provision is made that the royalty does not exceed a fixed percentage of the higher-grade ore.

MINE FINANCING IN CALIFORNIA [1]

By PHILIP S. MATTHEWS [2]

The tremendous stimulus given to the mining industry by the gold and silver policy of the present administration has found the capital market for mines ill prepared to afford the industry practical means of financing. Particularly has this been true of the host of abandoned high cost producers and prospects which increased gold and silver prices have made potentially profitable. In the short space of two years, experience has demonstrated abundantly that frequently valuable properties have failed, while questionable properties have drawn to themselves and their promoters more of the public moneys than their prospects justify. Singularly enough in most cases the fault is attributable to faulty financing. Discussion and study of this problem is vital to the industry.

At the outset it should not be necessary to condemn the practice of flooding the market with stock of prospects and partially developed mines principally for the purpose of enriching promoters. At the same time it must be clearly recognized that the greatest loss flows from the initiation of operations with inadequate capital. The difficulty of raising money and the inclination of promoters and even engineers to underestimate the amount of capital required, not to mention honest errors in calculation and judgment, persistently cooperate to throw upon the market ventures which are doomed to failure for lack of funds.

These considerations serve to emphasize two fundamental premises: first, that in successful mine financing there is no substitute for careful examination and conservative reports, not only as to the physical property and its potentialities, but as to the money required to prove or develop it, and second, that the project should not be undertaken until adequate capital has been made available.

Proven mines with proven values present little difficulty. If sufficient capital can not be obtained in customary channels, the authority of the Reconstruction Finance Corporation to make loans for development work or actual mining and milling operations will suffice at least to supplement available funds, if not to supply all that is needed.

Prospects and mines requiring further development work, on the other hand, involve the speculative element to such degree as to require careful financial planning.

From the point of view of the owners or promoters the prime consideration is that if the project is successful, they shall reap their fair reward; and that those who hazard their capital shall receive a reasonable return. In other words, there must be a fair relation between the profits accruing to the promoters and investors. The solution of the problem is complicated not only by existing security laws, but by the necessity of raising adequate capital to complete the work if the values are in the ground.

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[1] Presented at the San Francisco Section meeting of the American Institute of Mining and Metallurgical Engineers, April 9, 1935.

[2] Of Ackerman, Wayland and Matthews, attorneys, San Francisco.

The key to the problem is found in the type of organization to be used as the vehicle of the promotion. Of these there are four: a corporation, a limited partnership, a Massachusetts trust, and a syndicate. These we shall consider separately.

Under existing conditions the corporation in most instances lends itself the least satisfactorily to the problem. Primarily this is due to existing security laws.

In California, the Corporate Securities Act is administered for the protection of the investor. The host of fly-by-night and foolish ventures, with which the Division of Corporations in administering the act has been flooded, has necessitated the adoption of rules which definitely limit the extent to which the promoters or owners may profit from their venture. These rules are substantially as follows:

Stock may be issued free of escrow for money paid, appraised value of fixtures and personal property, land value and ore in sight; in other words, for actual tangible values only. All other stock will be escrowed and may not be freed from escrow until its value has been demonstrated by actual earnings. The promoters or owners will be allowed only one additional share for each share issued for money paid in or its equivalent. If, therefore, the property is in the prospect class and no money has been expended upon it prior to the filing of the application with the Division of Corporations, the promoters will be allowed only one share for each share sold to the public. Nothing will be allowed for the potential value of the property itself. Even if enough work has been done on the property to justify the engineer in concluding that it has a tangible value, the answer is the same. The promoters or owners will be permitted to issue stock to themselves only against the money expended on the property and ore blocked out. Beyond this and the share for share promotional stock, they will get nothing for the property's potential value, no matter how great it may be.

Assuming even that the original financing through a corporation is successful, further difficulties and expense are to be encountered in the not infrequent later need for additional financing. Even if the Division of Corporations will authorize the sale of additional stock in the face of this mistake in planning, the difficulty of selling it to the public and the disillusioned shareholders is frequently insurmountable.

Lastly, if a large amount of money is needed, the marketing of the stock either in connection with original or supplemental financing may require compliance with the Federal Securities Act of 1933, which will be discussed later.

Sufficient has been said to show that in most instances, the corporate form of organization is impractical and to suggest that it is suitable only for a producing property.

The limited partnership is the second form of organization which may be utilized. For a small group it is very simply set up, without the need of a permit from the Commissioner of Corporations. On the other hand, it lacks the elasticity necessary to the proper financing and management of an undertaking such as a mining property.

The general partners conduct the business and ordinarily have the larger interest in the profits. The limited partners supply only capital, in money or property, upon which they may receive not only interest, but a share of the profits. The limited partners, however, may not take any part in the business. In effect, they are the equivalent of nonvoting preferred shareholders. Each of the general partners is liable for every debt incurred by the partnership. The limited partners are subject to no liabilities beyond the loss of the capital which they may contribute.

Such an organization may be deemed ideal for a small group who among themselves can supply all money that may be needed at any stage of the work. In cases where additional capital must be attracted to the enterprise, the following objections arise:

First: It is difficult to center responsibility or foster initiative among a group of general partners, each of whom theoretically has an equal voice in the business.

Second: A contributor of capital may not be content either with the status of a limited partner, which denies him any real voice in the business, or that of a general partner which subjects him to unlimited liabilities.

Third: Every change in the membership of the partnership, every shift of capital or major amendment in the partnership agreement requires a cumbersome and technical legal procedure, which may cause expensive or disastrous delay.

Fourth: Interests in the partnership are not readily salable to the public to raise additional capital, hence further financing is impeded.

The Massachusetts trust, the third form of organization, is sometimes thought available as a means of obtaining the advantages of a corporation and a limited partnership free from their objectionable features. Without explaining the legal structure of this highly technical creature of the law, it is sufficient to say that the management is placed in the hands of trustees who issue certificates of beneficial interest in exchange for the property contributed by the owners or promoters and for the money supplied by the investors. To insure the proper protection of the holders of certificates of beneficial interest against liability, substantially all power and authority must be vested in the trustees. Thus the investor is denied any voice in the conduct of the venture. The certificates of beneficial interest are securities under the California Corporate Securities Act and the Federal Securities Act of 1933. Hence the organization is subject to all of the difficulties created by those laws in the case of a corporation.

Combining the best features of the forms of organization already discussed is the so-called syndicate agreement, which is the fourth form of organization. This seems best suited to the requirements of initial financing. It has the flexibility and the freedom of action which is demanded for a property in the early stages of its development. It is formed with an initial capital in an amount estimated by the engineers as adequate either to prove the property or to carry on the development work until production is obtained.

Usually interests in the syndicate are divided into three parts. First is the interest of the owner of the property or of the lease and bond, who transfers to the syndicate an undivided interest in the property or the lease and bond or a right to share in a part of its production. Second, is the interest of the syndicate managers, usually the owners of the lease and bond, who may either donate their services or may receive a portion of the profits for assuming the responsibility of managing the project. Third, is the interest of the subscribers who receive units in proportion to their respective contributions of capital and share ratably in the portion of the profits not allotted to the owner and managers.

The following example will illusrate the division of interests. The owner of the property or the lease and bond has contributed to the syndicate an undivided sixty per cent interest in the property or in the lease and bond, retaining a forty per cent interest. The subscribers agree to supply $20,000 in money. This cash capital is divided into twenty units of $1,000 each. The holder of each unit is, therefore, entitled to a twentieth part of sixty per cent of the whole interest in the property or in the lease and bond.

Assume that after a trial period the syndicate finds itself inadequately financed. It is a simple matter to provide additional capital through the sale of additional units. The interests of the owners in the property are ordinarily not disturbed unless there is a provision in the agreement that the owners must give up a portion of their share if additional syndicate units must be sold.

If the property gets into commercial production, provision is made for organization of a corporation and the transfer by the managers of the whole interest in the syndicate to the corporation in return for its stock which, of course, is divided among owners and subscribers in proportion to their interests in the syndicate agreement.

The managers act as the executives of the syndicate and are given wide powers without the prior approval of the subscribers. This freedom of action and latitude of powers are among the most beneficent features of the syndicate form of organization. When a property is in the prospect or development stage, prompt and decisive actions are often demanded and the managers, who are in close contact with the property and the engineering staff, and are better qualified to make such decisions than a board of directors or a group of partners, most of whom ordinarily are inexperienced and insufficiently informed. On the other hand provision is made for the removal of any manager by the vote of the subscribers, should he prove incompetent or unsatisfactory.

In California it is necessary to obtain a permit from the Division of Corporations to sell the units. This can be obtained by filing an application, supported by an engineer's report, an attorney's opinion on title, and copies of any relevant agreements.

While experience with this form of organization usually gives entire satisfaction, there is but one drawback which sometimes creates selling resistance. The liability of the subscribers is like that of partners. They do not have the exemption from liability which they would enjoy as shareholders of a corporation. This difficulty is met by providing in the syndicate agreement that the managers may incur no liabilities in excess of money on hand available for the payment thereof. Legal counsel supervises the conduct of the managers and, when a purchase is made on credit, require a clause in the contract to the effect that the seller has notice of the provision of the agreement so limiting the power of the managers and thus protecting the subscribers from personal liability for the debts of the syndicate. The syndicate managers are also required to insure against other forms of liability. If these precautions are taken there is only a remote chance of liability on the part of the subscribers beyond the amount of their respective subscriptions.

The advantages of the syndicate may be summarized as follows: The initial prospect work or development of the property is placed in the hands of a small group of experienced men, thus centralizing responsibility. The capital requirements are restricted to the actual needs of the property in its initial proof or development. If the property is proved or successully developed, ownership will have been retained in the whole venture in a comparatively small group. This small group will then be rewarded to a far greater extent than if they had sold shares to the public for $1 a share less a twenty per cent selling commission. Their interest in the property will be recognized by the Division of Corporations at its true value and, having taken the risk before the property was proved or developed, they will not be required in any further financing to yield so large a share of the profits to the investor.

Finally the syndicate adapts itself more readily than the corporation to the problems created by the Securities Act of 1933. Under this law issues of stock and other securities, with certain exceptions, before offered to the public must be registered with the Securities and Exchange Commission at Washington, D. C. This procedure is not only troublesome, but occasions undue expense and delay, oftentimes presenting insurmountable obstacles. The units and shares of a syndicate, as well as shares of stock in corporations and certificates of beneficial interest in a Massachusetts trust, are securities within the meaning of this law, but it is usually possible so to organize a syndicate as to exempt its units or shares from the operation of the law.

Thus issues under $30,000 in money value usually are exempt. Issues of a corporation organized and doing business within a single state or of a group of individuals resident and doing business within a single state are exempt if sold only to persons resident in that state. Again, issues sold for cash amounting to less than $100,000 and not involving any promotional interest (or having a promotional interest subordinated to the interests of cash investors) are also exempt.

It is generally possible under the syndicate plan so to arrange the initial financing and organization as to qualify under one of these exemptions. After the property has been sufficiently developed or brought into production by the syndicate, there should be no hesitation in complying with the Securities Act of 1933, if public financing on a larger scale is necessary or desirable.

On the other hand, in the case of a corporation it is desirable, if not necessary, at the outset to raise the maximum amount of capital which may be required. This may be so large and the distribution of securities may be so broad as to make it impractical to qualify under one of the enumerated exemptions under the Securities Act of 1933.

While the advantages of the syndicate have been emphasized in the foregoing discussion, it is implicit in what has been said that another form of organization in certain instances may be necessary or desirable. A venture on a large scale requiring an unusual amount of capital may necessitate resort to the corporate form with all of its difficulties. A small operation involving few interests may readily lend itself to a limited partnership or a simple partnership. In a word, the cloth must be cut to fit the customer.

In discussing thus briefly a few of the problems encountered in mine financing, there is no desire to obscure the fact so well known to mining engineers that the ultimate success or failure of a mine must depend upon the presence and accessibility of mineral values in the ground. For the solution of this physical problem there is no substitute for sound engineering counsel. It must, nevertheless, ever be borne in mind that the proper solution of the financing problem may play an important part in assuring deserved success of the venture and in thus justifying the engineer's judgment.

NEW LAWS MAKE RADICAL CHANGE IN MINING RIGHTS

DISCOVERY WORK

For many years all of the western mining states except California and Utah have required certain 'location' or 'discovery' work when taking up a claim. This requirement greatly curtails the indiscriminate location and holding of numerous claims for speculative purposes and tends to prevent jumping of claims due to lack of proper monumenting.

The new Californian statute patterned after those of Nevada and Arizona which became effective on September 15, 1935, applies to all claims located on and after that date.

The text of the act follows:

An act to amend section 1426a of and to add sections 1426da, 1426db, 1426dc, and 1426ra to the Civil Code, relating to discovery locations and to discovery shafts on lode and placer mining locations.

The people of the State of California do enact as follows:

SECTION 1. Section 1426a of the Civil Code is hereby amended to read as follows:

1426a. The locator or locators of any lode mining claim must define the boundaries of such claim so that they may be readily traced, but, in no case, shall the claim extend more than fifteen hundred feet along the course of the vein or lode, nor more than three hundred feet on either side thereof as measured from the center line of the vein at the surface. On all lode mining claims made after this act takes effect and within sixty days after the location of the claim, the locator or locators shall erect at each corner of the claim and at the center of each end line, or the nearest accessible points thereto, a post not less than four inches in diameter, or a stone monument at least eighteen inches high.

SEC. 2. Section 1426da is hereby added to the Civil Code to read as follows:

1426da. On every lode mining or placer claim, located after this act takes effect, the locator or locators thereof shall, within ninety days after the date of location, sink a discovery shaft upon such claim at the point of discovery to a depth of at least ten feet from the lowest part of the rim of such shaft at the surface, exposing the deposit upon which discovery and location is based, or shall drive a tunnel, adit, or open cut upon such claim at the discovery point to at least ten feet below the surface, exposing the deposit upon which such discovery and location is based.

SEC. 3. Section 1426db is hereby added to the Civil Code to read as follows:

1426db. On all placer mining locations containing more than twenty acres, located after this act takes effect the locators thereof shall, within ninety days after the date of location, perform at least one dollar's worth of work for each acre included in such claim. This work may all be done at one place on the claim if so desired, and must be actual mining development work exclusive of cabins, buildings, or other surface structures. Nothing in this section shall be construed as a modification of the requirements of section 1426da of this code.

SEC. 3. Section 1426dc is hereby added to the Civil Code to read as follows:

1426dc. The relocation of any lode or placer mining location which is subject to relocation shall be made in the same way as an original location is herein required by law to be made, except that the relocator may either sink a new shaft upon the ground relocated at the discovery point to the depth of at least ten feet from the lowest part of the rim of such shaft at the surface, exposing the deposit upon which location is based, or drive a new tunnel, adit, or open cut upon such ground at the point of discovery to at least ten feet below the surface, exposing the deposit upon which location is based; or the relocator may sink the original discovery shaft ten feet deeper than it is at the time of relocation, or drive the original tunnel, adit, or open cut upon such claim ten feet further.

SEC. 4. Section 1426ra is hereby added to the Civil Code to read as follows:

1426ra. The failure or neglect of the locator or locators to comply with the requirements of sections 1426, 1426a, 1426da, 1426db, or 1426dc of this code shall render such location null and void, and no portion of the area within such location shall be subject to relocation by the same locator or locators within the period of three years from the date of such void location.

GRUBSTAKE CONTRACTS MUST NOW BE RECORDED

Another new law which also became effective on September 15, 1935, provides that

SECTION 1. All grubstake contracts and prospecting agreements hereafter entered into, and which may in any way effect the title of mining locations, or other locations under the mining laws of this State, shall be void and of no effect unless the instrument has first been recorded in the office of the county recorder of the county in which said instrument is made. The instrument or instruments shall be duly acknowledged before a notary public or other person competent to take acknowledgments. Grubstake contracts and prospecting agreements, duly acknowledged and recorded as provided for in this act, shall be prima facie evidence in all courts in this State in all cases wherein the title to mining locations and other locations under the mining laws of this State are in dispute.

SECURITY FOR THE PAYMENT OF MINERS' WAGES

As amended at the last session of the Legislature, Section 1 of the "Act to require security for the payment of wages of persons engaged in the mining industry" now reads as follows:

SECTION 1. Every person, firm or corporation engaged in the business of extracting, or of extracting and refining or reducing metals or minerals other than petroleum, other than parties having a free and unencumbered title to the fee of the property being worked, and also other than mining partnerships in respect to the members of the partnerships, must, before commencing work in any period for which a single payment of wages is made, have on hand either physically or by deposit with a bank or trust company, in the county where such property is located, or, if there is no bank or trust company in the county, then in the bank or trust company nearest the property, cash or readily salable securities of a market value equivalent to such cash, in a sufficient amount to make the payment of wages of every person employed on the mining property, or in connection therewith, for such period.

ADMINISTRATIVE

WALTER W. BRADLEY, State Mineralogist

Personnel.

There have been no changes of personnel in the Division of Mines to be noted during the past three months.

New Publications.

'California Journal of Mines and Geology'—the April, 1935, quarterly is in press and will be available for distribution shortly.

Bulletin No. 111, 'California Mineral Production for 1934,' will be in the printer's hands soon, and should be ready for distribution in December.

Commercial Mineral Notes, Nos. 146 and 147, June and July, 1935, respectively. These 'Notes' contain the lists of 'mineral deposits wanted,' and 'mineral deposits for sale,' issued in the form of a mimeographed sheet monthly. It is mailed free to those on the mailing list for "California Journal of Mines and Geology" and to others on payment of 15 cents postage paid in advance for the year. As an evidence of the interest in mines and mineral resources now showing considerable activity, this mimeographed 'sheet' has had to be expanded to two and three pages in recent months.

Mails and Files.

The Division of Mines maintains, in addition to its correspondence files and the library, a mine file which includes original reports on the various mines and mineral properties of all kinds in California.

During each quarterly period there are several thousand letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, marketing of refined products, and mining law. In addition to this, hundreds of oral questions are answered daily, both at the main office and the district offices, for the many inquirers who come in for personal interviews and to consult the files and library.

MINERALS AND STATISTICS

Statistics, Museum, Laboratory

HENRY H. SYMONS, Statistician and Curator

STATISTICS

Tabulations are presented herein showing the completed totals for all substances for the year 1934 grouped by substances and by counties. The complete, detailed annual report on the mineral production of California for 1934 will be available, as Bulletin No. 111 of the State Division of Mines.

Summary for 1934.

The total value of the mineral output of California for the year 1934 was $237,374,709, being an increase of $30,885,651 over the total of 1933 which was $206,489,058. There were fifty-nine different mineral substances, exclusive of a segregation of various stones grouped under gems; and all fifty-eight counties of the state contributed to the list.

As revealed by the data following, the salient features of 1934 compared with the previous year were: All mineral groups and practically all of the important mineral substances showed an increased value, lead by petroleum, gold, borates, cement, miscellaneous stone, silver, mineral water, quicksilver, tungsten ore, diatomite, brick and hollow building tile. Those showing a decrease in value were natural gas, copper, potash, limestone.

Of the fuels, petroleum showed an increase in value of $16,465,699 and an increase in amount from 172,139,362 barrels to 174,721,282 barrels of crude oil. The average prices received for all gravities of crude oil were slightly higher than in 1933 and the prices for 1934 were those that took effect on September 6, 1933 and continued the same throughout the year. Natural gas showed a decrease in amount utilized from 271,743,544 M cu. ft. to 263,207,517 M cu. ft. with a decreased total value from $15,403,514 to $14,408,761.

Of the metals, the gold yield showed an increase from 613,578.85 fine ounces to 719,063.92 fine ounces and in value from $15,683,075 to $25,131,284. The gold value in 1934 was calculated on a weighted value of $34.95 per fine ounce while that for 1933 was $25.56 per fine ounce. Silver increased from 402,591 fine ounces worth $140,907 to 844,413 fine ounces worth $545,883 and quicksilver from 4,102 flasks valued at $229,472 to 7,946 flasks worth $534,135; lead, tungsten and zinc also showed an increased output and value while copper and chromite decreased in value of production. Iron and manganese ores were again added to the active list.

Of the structural materials, cement increased from 7,284,031 barrels worth $10,331,395 to 8,936,085 barrels valued at $12,445,616; miscellaneous stone from a total value of $6,871,580 to $7,131,330; brick and hollow building tile from $1,520,481 to $1,644,661; and granite, lime, magnesite, bituminous rock and sandstone also showed increases for the year. Decreases were registered by marble (including onyx and travertine) and slate.

Of the industrial materials, increased values were registered by mineral water, barytes, diatomite, silica, pottery clay, pyrite, and talc and soapstone; with slight decline in value shown by gypsum, dolomite, limestone, pumice and volcanic ash. The total value of this group increased from $3,658,249 to $4,276,566.

Of the salines, increases in total values were shown by borates, magnesium salts, bromine and calcium chloride, all other materials in this group showed a decreased value. The group as a whole showed an increase in total value from $8,652,224 to $10,413,019.

The distribution of the 1934 output of California by substance is shown in the following tabulation:

Substance	Amount	Value	Number of producers
Barytes	21,769 tons	$125,514	5
Bentonite	6,168 tons	69,325	7
Borates	240,696 tons	5,524,262	4
Brick and hollow building tile		1,644,661	50
Cement	8,936,085 bbls.	12,445,616	10
Chromite	294 tons	3,498	3
Clay (pottery)	190,510 tons	245,900	49
Coal	13,549 tons	52,720	4
Copper	590,683 lbs.	47,252	[e]6
Gems		2,456	9
Gold	719,084 fine oz.	25,131,284	[a]
Granite		249,083	15
Gypsum	58,149 tons	113,606	6
Iodine	355,279 lbs.	423,016	3
Lead	804,911 lbs.	29,782	[e]8
Lime	32,500 tons	309,765	21
Limestone	198,057 tons	461,139	
Magnesium salts	2,325 tons	194,642	3
Marble (Onyx Travertine)		10,759	3
Mineral water	19,882,436 gals.	1,071,197	40
Natural gas	263,207,517 M cu. ft.	14,408,761	[b]
Petroleum	174,721,282 bbls.	159,529,671	[b]
Platinum	520 oz.	14,884	12
Pumice and Volcanic Ash	9,951 tons	54,248	10
Quicksilver	7,964 flasks	534,135	67
Salt	332,194 tons	1,222,810	11
Sandstone		14,245	10
Silica	70,432 tons	296,643	7
Silver	844,413 fine oz.	545,883	[e]43
Slate	5,065 tons	24,245	3
Soapstone and talc	13,920 tons	158,606	6
Soda	99,380 tons	1,219,561	4
Stone, miscellaneous	[c]	7,131,330	334
Sulphur	4,412 tons	67,656	3
Tungsten ore	261 tons	224,417	3
Zinc	721,719 bbls.	31,034	[e]1
Unapportioned	[d]	3,741,103	[d]
Total value		$237,374,709	

[a] There were 867 lode mines and 1,784 placer mines, not including snipers, prospectors, and various individuals who sold small lots.

[b] There was an average of 11,444 producing wells.

[c] Includes macadam, crushed rock, ballast, rubble, riprap, sand and gravel.

[d] Includes asbestos (1), bituminous rock (3), bromine (2), calcium chloride (2), carbon dioxide (1), diatomite (6), dolomite (3), feldspar (1), fluorspar (1), iron ore (2), magnesite (2), manganese ore (3), molybdenum ore (1), potash (4), pyrite (2), sillimanite-andalusite-cyanide group (2), paving blocks (2), tube mill pebbles (2), wollastonite (1).

[e] Also included under gold.

Distribution by counties is given in the following tabulation:

County	*Value*	*Number of mineral products*
Alameda	$2,379,633	10
Alpine	25,431	6
Amador	2,400,161	10
Butte	637,962	11
Calaveras	2,196,592	9
Colusa	45,875	6
Contra Costa	1,734,999	8
Del Norte	81,998	5
El Dorado	1,738,576	11
Fresno	5,772,807	15
Glenn	30,608	1
Humboldt	81,432	7
Imperial	108,480	10
Inyo	1,293,725	17
Kern	37,053,187	19
Kings	28,067,389	6
Lake	260,481	6
Lassen	28,318	4
Los Angeles	66,359,227	16
Madera	264,142	6
Marin	183,354	4
Mariposa	807,908	8
Mendocino	14,351	3
Merced	1,050,492	7
Modoc	48,117	6
Mono	212,438	10
Monterey	190,902	13
Napa	398,214	8
Nevada	7,488,996	7
Orange	25,746,031	9
Placer	678,232	11
Plumas	181,143	7
Riverside	2,590,545	14
Sacramento	3,877,757	10
San Benito	266,857	3
San Bernardino	10,537,050	25
San Diego	487,266	15
San Francisco	28,641	2
San Joaquin	148,097	6
San Luis Obispo	138,453	11
San Mateo	1,562,490	8
Santa Barbara	7,570,191	8
Santa Clara	386,445	9
Santa Cruz	1,796,844	10
Shasta	1,145,180	8
Sierra	1,046,307	5
Siskiyou	648,166	9
Solano	23,641	2
Sonoma	162,005	5
Stanislaus	418,127	7
Sutter	3,322	1
Tehama	39,575	3
Trinity	650,620	8
Tulare	184,474	11
Tuolumne	423,588	9
Ventura	13,688,749	10
Yolo	38,027	4
Yuba	1,951,046	5
Total value	$237,374,709	

MUSEUM

The Museum of the State Division of Mines possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Division of Mines as well as by those who utilize the facilities of the collection.

Among the specimens received recently and catalogued for the Museum are the following:

20601 LODESTONE, a variety of Magnetite, which is a natural magnet.
From: Eagle Mountain, Riverside County, California
Donor: John Melhase, May 1, 1935

20602 PROBERTITE (Kramerite) $Na_2O.2CaO. 5B_2O_3.10H_2O$
From: Kramer, Kern County, California
Donor: John Melhase

20603 MOLYBDENITE in Hornblende
From: Clyfton, Utah
Donor: John Melhase

20604 GOLD, native in PYRITE
From: Keystone Mine, Amador City, California
Loaned: Walter W. Bradley

20605 MOLYBDENITE
From: 8 miles from Coleville, Mono County
Donor: A. P. Linville and C. C. Coffman
1701 Alston Way, Berkeley, California

20606 BARITE (barium sulphate) with some iron oxides present which cause the discoloration
From: Adorf, Westphalia, Germany
Donor: Fred Fegee

20607 CINNABAR (HgS)
From: Santa Ynez Mercury Mine, near Santa Ynez
Donor: Oscar E. Hanno
Santa Barbara, California

20608 OIL SHALE (with fossil shells filled with bitumen)
From: Old N.T.U. quarry (now Lineberger) near Casmalia
Donor: Eric Warner
c/o Lineberger Trust, Casmalia, California

20609 BLACK SLATE
From: McLean Quarry, near Jamestown, Tuolumne County, California
Donor: Walter S. McLean
419 Bay Shore Blvd., San Francisco, California

20611 MOHAWKITE $(Cu,Ni,Co)_3$ As, associated with DOMEYKITE (CuAs) and ALGODONITE (Cu_6As)
From: Mohawk Mine, Keweenaw Peninsula, Michigan
Donor: John Melhase

20612 SAND CONCRETIONS
From: Signal Mountain, Imperial County, California
Donor: Mrs. Anna P. Lightburn

20613 BARITE ($BaSO_4$) well crystallized
From: Palos Verdes Estates
Los Angeles, California
Donor: Mrs. Anna P. Lightburn

20614 WOLLASTONITE and CALCITE
From: Crestmore, Riverside County, California
Donor: Mrs. Anna P. Lightburn

20615 GARNET
From: Crestmore, Riverside County, California
Donor: Mrs. Anna P. Lightburn

20616 CRESTMOREITE ($4H_2CaSiO_4.H_2O$) on calcite
From: Crestmore, Riverside County, California
Donor: Mrs. Anna P. Lightburn

20617 CALCITE ($CaCO_3$)
From: Crestmore, Riverside County, California
Donor: Mrs. Anna P. Lightburn

20618 MIXITE ($(20CuO)\ Bi_2O_3.\ 5As_2O22H_2O.$) (green) on Quartz
From: Schneeberg, Sachsen, Germany
Donor: John Melhase

20619 TILASITE ($(Mg,F)\ CaAsO_4$) (rose color)
From: Langbanshyttan, Sweden
Donor: John Melhase

20620 BERZELITTE ($(Ca,Mg,Mn)\ 3As_2O_8$) (yellow)
From: Langbanshyttan, Sweden
Donor: John Melhase

20621 OCHROLITE ($(Pb_4Sb_2O_7.2PbCl$? (yellow) on Magnetite
From: Langbanshyttan, Sweden
Donor: John Melhase

20622 SARKINITE ($4MnO.As_2O_5.H_2O$) reddish
From: Langbanshyttan, Sweden
Donor: John Melhase

20623 POLLUCITE ($H_2O.2Cs_2O.\ 2Al_2O_3.9SiO_2$) hydrous caesium aluminum silicate
From: Naylor Gem Mine
Mesa Grande, San Diego County, California
Donor: Ernest Schernikow

20624 BARITE ($BaSO_4$) excellent large crystals
From: Palos Verdes Estates
Los Angeles County, California
Donor: Norman Smith

20625 STIBICONITE $H_2Sb_2O_5$) hydrous antimony oxide
pseudomorph after Stibnite
From: San Jose Mines, Wadley, San Luis Potosi, Mexico
Donor: J. B. Harper

20626 DUMORTIERITE (cut)
From: San Diego County, California
Donor: Francis J. Sperisen
166 Geary Street, San Francisco

20627 JASPER (rough and cut)
From: The excavation of the north pier of Golden Gate Bridge,
Marin County, California
Donor: Francis J. Sperisen
166 Geary Street, San Francisco

LABORATORY

FRANK SANBORN, Mineral Technologist

The laboratory of the Division of Mines is maintained for the purpose of identifying minerals and making qualitative analyses of rocks. These determinations and analyses are made without cost to those who seek the services of this state department. Ordinarily, a small sample weighing not over half a pound, in the lump form if possible, should be submitted with a letter stating what particular tests are desired, if there is a special reason for sending the material. Not more than three samples should be sent at one time, nor is it necessary to send more than one. Information regarding the size of the deposit and its proximity to rail transportation is useful in determining the possible value of a mineral body.

When requested, assistance in finding a market for a mineral will be given. When such help is desired, a small representative sample of the material for which a market is sought should accompany the request. The Division is sometimes able to send a very small sample of a particular mineral for comparative purposes to any earnest prospector. Prospecting and exploitation of the state's mineral wealth increases as the state becomes more thickly populated. Each year new occurrences of some mineral in the state are reported and occasionally a new mineral species is found. New uses for a mineral are frequently found, and as a result stimulus is given to searching for that particular substance.

LIBRARY

Herbert A. Franke, Librarian

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the Division of Mines contains over six thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, California Journal of Mines and Geology contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED

Governmental, National.

U. S. Geological Survey:

Bulletins:

847A—Contact Mining District, Nevada. By F. C. Schrader.
856 —Geology of Big Horn County and the Crow Indian Reservation, Montana.

Professional Papers:

181—Upper Eocene Foraminifera of the Southeastern U. S. By J. A. Cushman.

Water Supply Papers:

744—Part 4—St. Lawrence River Basin.
745—Part 5—Hudson Bay and Upper Mississippi River Basins.
747—Part 7—Lower Mississippi River Basin.
748—Part 8—Western Gulf of Mexico Basins.
749—Part 9—Colorado River Basin.
751—Part 11—Pacific Slope Basins in California.
753—Part 12—North Pacific Slope Basins.
754—Part 12—North Pacific Slope Basins.
755—Surface Water Supply of Hawaii.

U. S. Bureau of Mines:

Bulletins:

381—Lead and Zinc Mining and Milling in the U. S. Current Practices and Costs. By Jackson, Knaebel & Wright.

Technical Papers:

556—A Study of Some Seisometers. By G. A. Ireland.
562—Carbonizing Properties and Constitution of Alma Bed Coal From Spruce River No. 4 Mine, Boone County, West Va.
563—A Study of Mine Roof in the Coking District of Western Pennsylvania. By Paul & Plein.

Report of Investigations:

3274—Accuracy of Manometry of Explosions:
General Survey of the Problem and Comparison of Piston-Type with Diaphragm-Type Manometers. By H. F. Coward and M. D. Hersey.

Information Circulars:

6822—Mica. By F. W. Horton.
6834—The Fertilizer Industries. By Paul M. Tyler.
6836—Milling Methods and Costs at the Concentrator of the St. Joseph Lead Co., Atlanta, Idaho. By E. D. Gardner.
6837—Blasting Practices and Explosives Accidents in Utah Coal Mines. By J. D. Parker.
6838—A Few of the Opportunities for Obtaining Accident-Prevention Information Available to Mine Management and Employees Through the United States Bureau of Mines. By C. A. Herbert.
6839—Essentials in Developing and Financing a Prospect Into a Mine. By Chas. Will Wright.
6840—Review of Literature on Effects of Breathing Dusts With Special Reference to Silicosis; Part 11-A.
Chapter 4. Prevention of Dust Diseases (Section 1 and 2). By D. Harrington and Sara J. Davenport.
6842—Gold and Silver Custom Plants. By E. D. Gardiner.

Governmental, State.

California State Department of Public Works, Sacramento, Calif.
California Highway Transportation Survey, Reports and Atlas of Maps.

Florida Department of Conservation, Tallahassee:

Geol. Bull.: No. 12—New Miocene Gastropods and Scaphopods from Alaqua Creek Valley, Florida. By W. C. Mansfield.

Idaho Bureau of Mines and Geology, Moscow:

Pamphlet No. 42—Application of the Diesel Engine to Small Mines. By W. W. Staley.
Pamphlet No. 43—A Preliminary Report on the Geology and Ore Deposits of the Eastern Part of the Yellow Pine District, Idaho. By L. W. Currier.

Illinois State Geological Survey, Urbana:

R. I. No. 33—Mineral Matter of No. 6 Bed Coal at West Frankfort, Franklin Co., Ill. By C. G. Ball.
R. I. No. 37—Briquetting Illinois Coals Without a Binder by Impact. By R. J. Piersol.
R. I. No. 38—Proximate Analyses and Screen Tests of Coal Mine Screenings Produced in Illinois.

Indiana Division of Geology, Indianapolis:

Oil and Gas Developments in Indiana in 1934. By Logan and Kerr.

Mississippi State Geological Survey, University:

Bull. 26—The Highland Church Sandstone As a Building Stone. By W. C. Morse.

Bull. 27—Geologic Conditions Governing Sites of Bridges and Other Structures. By W. C. Morse.

Nebraska Geological Survey, Lincoln:

Groundwater Level Survey in Nebraska. By H. A. Waite.

Virginia Geological Survey, Charlottesville:

Bull. 39—James River Iron and Marble Belt, Virginia. By A. S. Furcron.

Governmental, Foreign.

Alberta Research Council, Edmonton:

Annual Reports.

Argentina Direccion General de Minas y Geologica, Buenos Aires:

Publications.

British Columbia Minister of Mines, Victoria:

Annual Report for 1934.

British Museum of Natural History, London:

Publications.

Canada Department of Mines, Ottawa:

744—Investigations in Ore Dressing and Metallurgy, July to December, 1933.
760—Canadian Mineral Industry in 1934.

Cuerpo de Ingenieros de Minas y Aguas del Peru, Lima:

Bulletins.

Geological Service of Minas Geraes, Bella Horizonte, Brazil:

Publications.

Geological Survey of Great Britain, London:

Memoirs, Geologic Maps, etc.

Geological Survey of Scotland:

Publications.

Instituto Historica e Geographico, Rio de Janeiro:

Publications.

Museo de Historia Natural de Montevideo, Uruguay:

Analas.

New South Wales Department of Mines, Sydney, Australia:

Annual Reports.

New Zealand Geological Survey Branch, Wellington:

Reports.

Nova Scotia Department of Public Works and Mines, Halifax:

Annual Reports.

Ontario Department of Mines, Toronto, Canada:

Bulletin 97—Report on the Mining Accidents in Ontario in 1934.
Bulletin 98—Prel. Report on the Mineral Production of Ontario in 1934.
Forty-third Annual Report of the Ontario Department of Mines.

Quebec Bureau of Mines, Quebec:

Part E, III—Commercial Granites of Quebec. North of St. Lawrence River.

Queensland Department of Mines, Brisbane, Australia:

Annual Reports.

South Australia Department of Mines, Adelaide:

Annual Reports, Mining Reviews, etc.

Western Australia Geological Survey, Perth:

Bulletin 95—The Physiography of Western Australia. By J. T. Jutson.

Transvaal Chamber of Mines, Johannesburg, So. Africa.
Publications.

Societies and Educational Institutions.

Academia de Ciencias y Artes de Barcelona, Spain:
Memoiras.

Academy of Natural Sciences of Philadelphia:
Proceedings.

American Association of Petroleum Geologists, Tulsa, Okla.:
Bulletins.

American Geographical Society of New York:
"Geographical Review."

American Journal of Science, New Haven, Conn.

American Philosophical Society, Philadelphia.
Proceedings.

Australian Museum, Sydney.
Records.

California Academy of Sciences, San Francisco:
Proceedings.

Canadian Institute of Mining and Metallurgy, Montreal:
"Canadian Mining and Metallurgical Bulletin."

Carnegie Institution of Washington:
Bulletins.

Cleveland Museum of Natural History, Cleveland, Ohio:
Scientific Publications.

Colorado College Publications, Colorado Springs.

Colorado Scientific Society, Denver:
Proceedings.

Commonwealth Club, San Francisco:
Journals.

Economic Geology, Lancaster, Pa.

Field Museum of Natural History, Chicago:
Geological Series.

Franklin Institute of the State of Pennsylvania, Lancaster, Pa.:
Journals.

Geological Society of America, Columbia University, New York:
Bulletins.

Geographical Society of London:
Abstracts of the Proceedings.

Golden Gate Bridge and Highway District, Building Committee, San Francisco, Calif.
Investigation of Criticism of Foundation by Dr. Bailey Willis.

Institution of Mining and Metallurgy, London:
Bulletins, Transactions.

Instituto Geologico de Mexico, Mexico, D. F.:
Bulletins.

Journal of Geology, Chicago.

Mineralogical Society of America, Menasha, Wisconsin.
"The American Mineralogist."

Michigan College of Mining and Technology, Houghton:
  Publications.

Mining and Metallurgical Society of America, New York:
  Bulletins.

Museu Nacional, Rio de Janeiro:
  Boletins.

National Research Council, Washington, D. C.:
  No. 95—Funds Available in the U. S. for the Support and Encouragement of Research in Science and Its Technologies, 1934.

New York Academy of Sciences, New York:
  Annals, etc.

New York State Museum, Albany:
  Publications.

Pennsylvania State College, State College:
  Bull. 44—Performance Tests of Lubricating Oils in Automobile Engines. By Everett & Stewart.

Philippine Journal of Science, Manila:
Royal Society of South Australia, Adelaide:
  Transactions and Proceedings.

Seismological Society of America, Stanford University:
  Bulletins.

Sierra Club, San Francisco.
  Bulletins.

Society of Economical Paleontologists and Mineralogists, Fort Worth, Texas:
  "Journal of Paleontology."

Southern California Academy of Sciences, Los Angeles:
  Bulletins.

University of California, Department of Geological Sciences:
  Vol. 23, No. 11—Mesozoic and Cenozoic Eruptive Rocks of the Southern Klamath Mountains, Calif. By N. E. A. Hinds.
  Vol. 23, No. 13—A Review of the Tertiary Beavers. By R. A. Stirton.

Books.

The Life of James W. Marshall. By G. F. Parsons.

Transactions of the A. I. M. E.:
  Copper Metallurgy, 1933.
  Geophysical Prospecting, 1934.
  Metal Mining and Non-Metallic Minerals, 1934.
  Milling Methods, 1934.

John Hays Hammond Public Mining Library:
  Alluvial Prospecting. By Raeburn and Milner.

Maps.

U. S. Geological Survey, Topographic Maps:

Arkansas:
  Treat Quadrangle.

Louisiana:
  Covington Quadrangle.
  Denham Springs Quadrangle.
  Ponchatoula Quadrangle.

Missouri:
  Poplar Bluff Quadrangle.
  Zalma Quadrangle.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
California Journal of Development, San Francisco.
California Mining Journal, Auburn.
California Oil World, Los Angeles.
California Safety News, San Francisco.
Canadian Mining Journal, Gardenvale, Quebec.
Chemical and Metallurgical Engineering, New York City.
Chemical Engineering and Mining Review, Melbourne, Australia.
Colorado School of Mines, Golden, Colorado.
Engineering and Mining Journal, New York City.
Fuel Oil, Chicago, Illinois.
Fusion Facts, Whittier, California.
Geophysical Prospector, Los Angeles.
Gold, Toronto, Canada.
Grizzly Bear, Los Angeles.
Hercules Mixer, Wilmington, Delaware.
Lubrication, The Texas Co., New York City.
Metals and Alloys, Pittsburgh, Pa.
Mineralogist, Portland, Ore.
Mining Congress Journal, Washington, D. C.
Mining Journal, London.
Mining Journal, Phoenix, Arizona.
Mining and Metallurgy, New York City.
Mining Review, Salt Lake City.
National Sand and Gravel, Washington, D. C.
Nickel Cast Iron News, New York City.
Northwest Science, Moscow, Idaho.
Northwest Mining, Spokane, Washington.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil, Paint and Drug Reporter, New York City.
Oil Weekly, Houston, Texas.
Pacific Purchaser, San Francisco.
Petroleum World, Los Angeles.
Pit and Quarry, Chicago.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago.
Rocks and Minerals, Peekskill, New York.
Scientific American, New York City.
Southwest Builder and Contractor, Los Angeles.
Stabilizer, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York City.
Western Mining News, San Francisco.

Newspapers.

The following papers are received and kept on file in the library:

Alaska Weekly, Seattle, Washington.
Amador Dispatch, Jackson, California.
Banner, Sonora, California.
Barstow Printer, Barstow, California.
Bridgeport Chronicle-Union, Bridgeport, California.
Calaveras Californian, Angels Camp, California.
Calaveras Prospect, San Andreas, California.

Colusa Sun-Herald, Colusa, California.
Daily Commercial News, San Francisco, California.
Daily Midway Driller, Taft, California.
Del Norte Triplicate, Crescent City, California.
Denver Mining Record, Denver, Colorado.
Georgetown Gazette, Georgetown, California.
Inland Oil Index, Casper, Wyoming.
Inyo Independent, Independence, California.
Inyo Register, Bishop, California.
Las Vegas Age, Las Vegas, Nevada.
Livermore Herald, Livermore, California.
Los Angeles Times, Los Angeles, California.
Mariposa Gazette, Mariposa, California.
Mercury Register, Oroville, California.
Mining & Industrial News, San Francisco, California.
Mojave Miner, Kingman, Arizona.
Mojave-Randsburg Record, Mojave, California.
Morning Union, Grass Valley, California.
Mountain Messenger, Downieville, California.
Needles Nugget, Needles, California.
Nevada City Nugget, Nevada City, California.
Nevada Mining Bulletin, Las Vegas, Nevada.
Oil Marketer, Bayonne, New Jersey.
Placer Herald, Auburn, California.
Plumas Independent, Quincy, California.
San Diego News, San Diego, California.
Shasta Courier, Redding, California.
Siskiyou News, Yreka, California.
Stockton Record, Stockton, California.
Tehachapi News, Tehachapi, California.
Terra Bella News, Terra Bella, California.
Tuolumne Independent, Sonora, California.
Tuolumne Prospector, Tuolumne, California.
Union Democrat, Sonora, California.
Ventura County News, Ventura, California.
Waterford News, Waterford, California.
Weekly Trinity Journal, Weaverville, California.
Western Mineral Survey, Salt Lake City, Utah.
Western Sentinel, Etna Mills, California.

PRODUCERS AND CONSUMERS

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by this Division to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of *Mining in California* was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of CALIFORNIA JOURNAL OF MINES AND GEOLOGY, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes,' and sent to those on the mailing list of CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

EMPLOYMENT SERVICE

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

Technical men, or those qualified for supervisory positions, and vacancies of like nature only, are registered, as no attempt will be made to supply common mine and mill labor.

Registration cards for the use of both prospective employers and employees may be obtained upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded. Parties interested should communicate direct with our San Francisco office.

PUBLICATIONS OF THE DIVISION OF MINES

During the past fifty-four years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the State, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have usually been limited, the reports and bulletins mentioned are printed in limited editions many of which are now entirely exhausted.

Copies of such publications are available, however, in the offices of the Division of Mines, in the Ferry Building, San Francisco; State Building, Los Angeles; State Office Building, Sacramento; Redding; and Division of Oil and Gas at Santa Barbara, Taft, Bakersfield. They may also be found in many public, private and technical libraries in California and other States and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

Money orders should be made payable to the Division of Mines.

NOTE.—The Division of Mines frequently receives requests for some of the early Reports and Bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

REPORTS

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----	----
Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	$0.50	$0.10
Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	.50	.10
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----	----
Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	1.00	.15
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	1.00	.20
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:		
Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	.50	.10
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50	.10
Mines and Mineral Resources, Del Norte, Humboldt and Mendocino Counties, 59 pp., paper	.25	.10
Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pp., paper	.50	.10
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.35	.10
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----	----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915: A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou and Trinity Counties, 974 pp., 275 illustrations, cloth	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916. Fletcher Hamilton:		
Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	.65	.10
Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties, 91 pp., paper	.50	.05
Mines and Mineral Resources, El Dorado, Placer, Sacramento and Yuba Counties, 198 pp., paper	.65	.10
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara and Ventura Counties, 183 pp., paper	.65	.10
Mines and Mineral Resources, Los Angeles, Orange and Riverside Counties, 136 pp., paper	.50	.10
Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	.65	.10

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	Price	Shipping Charges
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917: A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1917–1918, Fletcher Hamilton:		
Mines and Mineral Resources of Nevada County, 270 pp., paper	$0.75	$0.15
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50	.10
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50	.10
Seventeenth Report of the State Mineralogist, 1920, 'Mining in California during 1920,' Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75	.25
Eighteenth Report of the State Mineralogist, 1922, 'Mining in California,' Fletcher Hamilton. Chapters published monthly beginning with January, 1922:		
**January, **February, March, April, May, June, July, August, September, October, **November, December, 1922	.25	.05
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	.25	.05
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, **July, October, 1924, per copy	.25	.05
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange Counties	.25	.05
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura Counties	.25	.05
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego Counties	.25	.10
**October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara Counties	----	----
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
**January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz Counties	----	----
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial Counties	.25	.10
July, 1926, Mines and Mineral Resources of Marin and Sonoma Counties	.25	.05
**October, 1926, Mines and Mineral Resources of El Dorado and Inyo Counties, also report on Minaret District, Madera County	----	----
Chapters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1927, Mines and Mineral Resources of Contra Costa County; Santa Catalina Island	.25	.10
April, 1927, Mines and Mineral Resources of Amador and Solano Counties	.25	.05
**July, 1927, Mines and Mineral Resources of Placer and Los Angeles Counties	----	----
October, 1927, Mines and Mineral Resources of Mono County	.25	.05
Chapters of Twenty-fourth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1928, Mines and Mineral Resources of Tuolumne County	.25	.05
April, 1928, Mines and Mineral Resources of Mariposa County	.25	.05
July, 1928, Mines and Mineral Resources of Butte and Tehama Counties	.25	.05
October, 1928, Mines and Mineral Resources of Plumas and Madera Counties	.25	.05
Chapters of Twenty-fifth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
**January, 1929, Mines and Mineral Resources of Lassen, Modoc and Kern Counties; also on Special Placer Machines	----	----

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April, 1929, Mines and Mineral Resources of Sierra, Napa, San Francisco and San Mateo Counties	$0.25	$0.10
July, 1929, Mines and Mineral Resources of Colusa, Fresno and Lake Counties	.25	.10
October, 1929, Mines and Mineral Resources of Glenn, Alameda, Mendocino and Riverside Counties	.25	.10
Chapters of Twenty-sixth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1930, Mines and Mineral Resources of Santa Clara County; also Barite in California	.25	.05
April, 1930, Mines and Mineral Resources of Nevada County; also Mineral Paint Materials in California	.25	.05
July, 1930, Mines and Mineral Resources of Yuba and San Bernardino Counties; also Commercial Grinding Plants in California	.25	.10
October, 1930, Mines and Mineral Resources of Butte, Kings and Tulare Counties; also Geology of Southwestern Mono County (Preliminary)	.25	.10
Chapters of Twenty-seventh Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1931, Preliminary Report on Economic Geology of the Shasta Quadrangle. Beryllium and Beryl. The New Tariff and Nonmetallic Products. Crystalline Talc. Decorative Effects in Concrete	.25	.10
April, 1931, Stratigraphy of the Kreyenhagen Shale. Diatoms and Silicoflagellates of the Kreyenhagen Shale. Foraminifera of the Kreyenhagen Shale. Geology of Santa Cruz Island	.25	.10
July, 1931. (Yuba, San Bernardino.) Feldspar, Silica, Andalusite and Cyanite Deposits of California. Note on a Deposit of Andalusite in Mono County; its occurrence and chemical importance. Bill creating Trinity and Klamath River Fish and Game District and its effect upon mining	.25	.10
October, 1931. (Alpine.) Geology of the San Jacinto Quadrangle south of San Gorgonio Pass, California. Notes on Mining Activities in Inyo and Mono Counties in July, 1931	.25	.05
Chapters of Twenty-eighth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1932, Economic Mineral Deposits of the San Jacinto Quadrangle. Geology and Physical Properties of Building Stone from Carmel Valley. Contributions to the Study of Sediments. Sediments of Monterey Bay. Sanbornite	.25	.10
**April, 1932. Elementary Placer Mining Methods and Gold Saving Devices. The Pan, Rocker and Sluice Box. Prospecting for Vein Deposits. Bibliography of Placer Mining	----	----
Abstract from April quarterly: Elementary Placer Mining Methods and Gold Saving Devices. Types of Deposits, Simple Equipment. Special Machines. Dry Washing. Black Sand Treatment. Marketing of Products. Placer Mining Areas. Laws. Prospecting for Quartz Veins. Bibliography (mimeographed)	.20	.05
July-October. (Ventura.) Report accompanying Geologic Map of Northern Sierra Nevada. Fossil Plants in Auriferous Gravels of the Sierra Nevada. Glacial and Associated Stream Deposits of the Sierra Nevada. Jurassic and Cretaceous Divisions in the Knoxville-Shasta Succession of California. Geology of a Part of the Panamint Range. Economic Report of a Part of the Panamint Range. Acquiring Mining Claims Through Tax Title. The Biennial Report of State Mineralogist	.50	.15
Chapters of Report XXIX, 1933 (quarterly): titled "California Journal of Mines and Geology," containing the following:		
January-April. Gold Deposits of the Redding and Weaverville Quadrangles. Geologic Formations of the Redding-Weaverville District, Northern California. Geology of Portions of Del Norte and Siskiyou Counties. Applications of		

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Geology to Civil Engineering. The Lakes of California. Discovery of Piedmontite in the Sierra Nevada. Tracing 'Buried River' Channel Deposits by Geomagnetic Methods. Geologic Map of Redding-Weaverville District, showing gold mines and prospects. Geologic Map showing various mines and prospects of part of Del Norte and Siskiyou Counties	$0.80	$0.15
July-October. Gold Resources of Kern County. Limestone Deposits of the San Francisco Region. Limestone Weathering and Plant Associations of the San Francisco Region. Booming. Death Valley National Monument, California. Placer Mining Districts, Senate Bill 480. Navigable Waters, Assembly Bill 1543	.80	.10
Chapters of Report XXX, 1934 (quarterly): titled "California Journal of Mines and Geology," containing the following:		
January. Resurrection of Early Surfaces in the Sierra Nevada. Geology and Mineral Resources of Northeastern Madera County. Geology and Mineral Deposits of Laurel and Convict Basins, Southwestern Mono County. Notes on Sampling as Applied to Gold Quartz Deposits	.40	.10
April-July. Elementary Placer Mining in California and Notes on the Milling of Gold Ores	.80	.10
October. Current Mining Developments in Northern California. Current Mining Activity in Southern California. Geology and Mineral Resources of the Julian District, San Diego County. Geology and Mineral Resources of Elizabeth Lake Quadrangle. Dry Placers of Northern Mojave Desert. Biennial Report of State Mineralogist. Assessment Work Within Withdrawn Areas	.40	.10
Chapters of Report XXXI, 1935 (quarterly): titled "California Journal of Mines and Geology"		
January. Review of Gold Mining in East-Central, 1934. Current Mining Activities in the San Francisco District with Special Reference to Gold. Geological Investigation of the Clays of Riverside and Orange Counties, Southern California. Information regarding Mining Loans by the Reconstruction Finance Corporation	.40	.10
Subscription, $1.50 in advance (by calendar year, only).		
Chapters of State Oil and Gas Supervisor's Report:		
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free	----
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:		
**April, **May, **June, **July, **August, **September, **October, **November, **December, 1919	----	----
**January, **February, **March, **April, **May, **June, **July, **August, **September, **October, **November, **December, 1920	----	----
January, **February, **March, April, **May, **June, **July, August, **September, **October, **November, **December, 1921	Free	----
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BULLETINS

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**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations	----	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps	----	----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887)	----	----
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations	----	----
**Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations	----	----
**Bulletin No. 7. Mineral Production of California, by Counties, for the year 1894, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 8. Mineral Production of California, by Counties, for the year 1895, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations	----	----
**Bulletin No. 10. A bibliography Relating to the Geology, Paleontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	----	----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara Counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations	----	----
**Bulletin No. 12. Mineral Production of California, by Counties, for 1896, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 13. Mineral Production of California, by Counties, for 1897, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 14. Mineral Production of California, by Counties, for 1898, by Charles G. Yale	----	----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means, 1899	----	----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations	----	----
**Bulletin No. 17. Mineral Production of California, by Counties, for 1899, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations	----	----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps	----	----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899	----	----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet	----	----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet	----	----
**Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, 9 maps	----	----
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps	----	----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet	----	----
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**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet	----	----
**Bulletin No. 30. Bibliography Relating to the Geology, Paleontology and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp.	----	----
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet	----	----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps	----	----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet	----	----
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California	----	----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905. 120 pp., 66 illustrations, 3 maps	----	----
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905, 168 pp., 54 illustrations	----	----
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map	----	----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet	----	----
**Bulletin No. 41. Mines and Minerals of California for 1904, by Charles G. Yale. 1905, 54 pp., 20 county maps	----	----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps	----	----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.	----	----
**Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.	----	----
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Bulletin No. 50. The Copper Resources of California, 1908, by A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne and J. A. Edman. 366 pp., 74 illustrations. (Revised edition)	$1.00	$0.25
**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet	----	----
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**Bulletin No. 56. Mineral Production for 1908, with County Maps and Mining Laws of California, by D. H. Walker, 78 pp.	----	----
**Bulletin No. 57. Gold Dredging in California, by W. B. Winston and Chas. Janin. 1910, 312 pp., 239 illustrations, 10 maps	----	----
**Bulletin No. 58. Mineral Production of California, by Counties, by D. H. Walker. 1909. Tabulated sheet	----	----
**Bulletin No. 59. Mineral Production of California for Twenty-three Years, by D. H. Walker. 1909. Tabulated sheet	----	----
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**Bulletin No. 63. Petroleum in Southern California, by P. W. Prutzman. 1912, 430 pp., 41 illustrations, 6 maps	----	----
Bulletin No. 64. Mineral Production for 1911, by E. S. Boalich. 49 pp.	Free	$0.05
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**Bulletin No. 66. Mining Laws of the United States and California. 1914, 89 pp.	----	----
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**Bulletin No. 69. Petroleum Industry of California, with Folio of Maps (18 by 22), by R. P. McLaughlin and C. A. Waring. 1914, 519 pp., 13 illustrations, 83 figs. [18 plates in accompanying folio.]	----	----
**Bulletin No. 70. Mineral Production for 1914, with County Maps and Mining Laws. 184 pp.	----	----
**Bulletin No. 71. Mineral Production for 1915, with County Maps and Mining Laws, by Walter W. Bradley. 193 pp. 4 illustrations	----	----
**Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp.	----	----
**Reconnaissance Geologic Map (of which Bulletin 72 is explanatory), in 23 colors. Scale: 1 inch = 12 miles. Mounted	----	----
**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the Fiscal Year 1915–16, by R. P. McLaughlin. 278 pp., 26 illustrations	----	----
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Bulletin No. 76. Manganese and Cromium in California, by Walter W. Bradley, Emile Huguenin, C. A. Logan, W. B. Tucker and C. A. Waring. 1918, 248 pp., 51 illustrations, 5 maps, paper	$0.50	.10
Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880–1917, by E. S. Boalich. 44 pp. paper	Free	.05
Bulletin No. 78. Quicksilver Resources of California, with a Section on Metallurgy and Ore-Dressing, by Walter W. Bradley. 1919, 389 pp., 77 photographs and 42 plates (colored and line cuts), cloth	1.50	.35
Bulletin No. 79. Magnesite in California, by Walter W. Bradley. 1925, 147 pp., 62 photographs, 11 line cuts and maps, cloth	1.00	.10
†Bulletin No. 80. Tungsten, Molybdenum and Vanadium in California. (In preparation.)		
†Bulletin No. 81. Foothill Copper Belt of California. (In preparation.)		

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**Bulletin No. 84. Third Annual Report of the State Oil and Gas Supervisor, for the Fiscal Year 1917–1918, by R. P. McLaughlin. 1918, 617 pp., 28 illustrations, cloth	----	----
**Bulletin No. 85. Platinum and Allied Metals in California, by C. A. Logan, 1919. 10 photographs, 4 plates, 120 pp., paper	----	----
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**Bulletin No. 87. Commercial Minerals of California, with notes on their uses, distribution, properties, ores, field tests, and preparation for market, by W. O. Castello. 1920, 124 pp., paper	----	----
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**Bulletin No. 89. Petroleum Resources of California, with Special Reference to Unproved Areas, by Lawrence Vander Leck. 1921, 12 figures, 6 photographs, 6 maps in pocket, 186 pp., cloth	----	----
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**Bulletin No. 91. Minerals of California, by Arthur S. Eakle. 1923, 328 pp., cloth	----	----
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**Bulletin No. 94. California Mineral Production for 1923, by Walter W. Bradley. 1924, 162 pp., paper	----	----
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**Bulletin No. 97. California Mineral Production for 1925, by Walter W. Bradley. 1926, 172 pp., paper	----	----
Bulletin No. 98. American Mining Law, by A. H. Ricketts, 1931, 811 pp., flexible leather	3.00	.15
Bulletin No. 99. Clay Resources and Ceramic Industry of California, by Waldemar Fenn Dietrich. 1928, 383 pp., 70 photos, 12 line cuts including maps, cloth	1.50	.15
**Bulletin No. 100. California Mineral Production for 1926, by Walter W. Bradley. 1927, 174 pp., paper	----	----
**Bulletin No. 101. California Mineral Production for 1927, by Henry H. Symons. 1928, 311 pp., paper	----	----
Bulletin No. 102. California Mineral Production for 1928, by Henry H. Symons. 1929, 210 pp., paper	.25	.10
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Bulletin No. 109. California Mineral Production and Directory of Mineral Producers for 1932, by Henry H. Symons, 200 pp. paper	.25	.10
Bulletin No. 110. California Mineral Production and Directory of Mineral Producers for 1933, by Henry H. Symons, 214 pp. paper	.25	.10

PRELIMINARY REPORTS

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin, 4 pp.	----	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin, 4 pp.	----	----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp.	Free	$0.05
**Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper	----	----
Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper	Free	.05
**Preliminary Report No. 6. A Review of Mining in California During 1919. By Fletcher Hamilton, 1920. 43 pp. Paper	----	----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper	----	----
**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. By Fletcher Hamilton, 1922. 68 pp. Paper	----	----

MISCELLANEOUS PUBLICATIONS

	Price	Shipping Charges
**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper	----	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper	.10	----
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923	Free	.15 annually

MAPS

Register of Mines With Maps

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**Register of Mines, with Map, Amador County	----	----
Register of Mines, with Map, Butte County	$0.25	$0.05
**Register of Mines, with Map, Calaveras County	----	----
**Register of Mines, with Map, El Dorado County	----	----
**Register of Mines, with Map, Inyo County	----	----
**Register of Mines, with Map, Kern County	----	----
**Register of Mines, with Map, Lake County	----	----
**Register of Mines, with Map, Mariposa County	----	----
**Register of Mines, with Map, Nevada County	----	----
**Register of Mines, with Map, Placer County	----	----
**Register of Mines, with Map, Plumas County	----	----
**Register of Mines, with Map, San Bernadino County	----	----
Register of Mines, with Map, San Diego County	.25	.05
Register of Mines, with Map, Santa Barbara County (1906)	.25	.05
**Register of Mines, with Map, Shasta County	----	----
**Register of Mines, with Map, Sierra County	----	----
**Register of Mines, with Map, Siskiyou County	----	----
**Register of Mines, with Map, Trinity County	----	----
**Register of Mines, with Map, Tuolumne County	----	----
Register of Mines, with Map, Yuba County (1905)	.25	.05
Register of Oil Wells, with Map, Los Angeles City (1906)	.35	.05

OTHER MAPS

**Map of California, Showing Mineral Deposits (50 x 60 in.)	----	----
**Map of Forest Reserves in California	----	----
**Mineral and Relief Map of California	----	----
**Map of El Dorado County, Showing Boundaries, National Forests	----	----
**Map of Madera County, Showing Boundaries, National Forests	----	----
**Map of Placer County, Showing Boundaries, National Forests	----	----
**Map of Shasta County, Showing Boundaries, National Forests	----	----
**Map of Sierra County, Showing Boundaries, National Forests	----	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----	----
**Map of Mother Lode Region	----	----
**Map of Desert Region of Southern California	----	----
Map of Minaret District, Madera County	.20	.05
Map of Copper Deposits in California	.05	----
**Map of Calaveras County	----	----
**Map of Plumas County	----	----
**Map of Trinity County	----	----
**Map of Tuolumne County	----	----
Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60	.05
**Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	----	----
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Unmounted	.75	.05
Mounted	2.50	.15
**Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels, accompanying Bulletin No. 92. In 4 colors (also sold singly)	----	----

OTHER MAPS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
Geologic Map of Northern Sierra Nevada, showing Tertiary River Channels and Mother Lode Belt, accompanying July-October Chapter of Report XXVIII of the State Mineralogist. (Sold singly)	$0.25	$0.05
Map of Northern California, showing rivers and creeks which produced placer gold in 1932	.20	.05
Mother Lode Geologic and claim maps in 5 county sections: El Dorado, Amador, Calaveras, Tuolumne and Mariposa. Single sections 10c. Set of 5	.50	----
Map of Mariposa County showing principal gold mines	.10	----

OIL FIELD MAPS

The maps are revised from time to time as development work advances and ownerships change.

	Price (including postage)
Map No. 1—Sargent, Santa Clara County	$0.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	1.00
Map No. 3—Santa Maria, including Casmalia and Lompoc	1.00
Map No. 4—Brea Olinda & (East Portion) Coyote Hills, Los Angeles and Orange Counties	1.00
Map No. 6—Salt Lake-Beverly Hills, Los Angeles County	1.00
Map No. 7—Sunset and San Emidio, Kern County	1.00
Map No. 8—South Midway and Buena Vista Hills, Kern County	1.00
Map No. 9—North Midway and McKittrick, Kern County	1.00
Map No. 10—Belridge and McKittrick Front, Kern County	1.00
Map No. 11—Lost Hills and North Belridge, Kern County	1.00
Map No. 12—Devils Den, Kern County	.75
Map No. 13—Kern River, Kern County	1.00
Map No. 14—Coalinga, Fresno County	1.25
Map No. 15—Elk Hills, Kern County	1.00
Map No. 16—Ventura-Ojai, Ventury County	1.00
Map No. 17—Santa Paula–Sespe, including Bardsdale, South Mountain and Camarillo, Ventura County	1.00
Map No. 18—Piru-Simi-Newhall, Ventura County	1.00
Map No. 19—Arroyo Grande, San Luis Obispo County	.75
Map No. 20—Long Beach, Los Angeles County	1.50
Map No. 21—Portion of District No. 4, showing boundaries of oil fields—Kern and Kings Counties	.75
Map No. 21-A—Portion of District No. 4, showing boundaries of oil fields—Kern County	.75
Map No. 21-B—Portion of District No. 5, showing boundaries of oil fields—Fresno, Kings and Kern Counties	.75
Map No. 22—Portion of District No. 3, showing boundaries of oil fields—Santa Barbara County	.75
Map No. 23—Portion of District No. 2, showing boundaries of oil fields—Ventura County	.75
Map No. 24—Portion of District No. 1, showing boundaries of oil fields—Los Angeles and Orange Counties	1.00
Map No. 26—Huntington Beach, Orange County	1.25
Map No. 27—Santa Fe Springs, Los Angeles County	1.00
Map No. 28—Torrance, Los Angeles County	1.00
Map No. 29—Dominguez, Los Angeles County	.75
Map No. 30—Rosecrans, Los Angeles County	.75
Map No. 31—Inglewood, Los Angeles County	1.00
Map No. 32—Seal Beach, Los Angeles and Orange Counties	1.00
Map No. 33—Rincon, Ventura County	1.00
Map No. 34—Mt. Poso, Kern County	.75
Map No. 35—Round Mountain, Kern County	.75
Map No. 36—Kettleman Hills, Fresno, Kings and Kern Counties	1.25
Map No. 37—Montebello, Los Angeles County	1.00
Map No. 38—Whittier, Los Angeles County	1.00
Map No. 39—West Coyote, Los Angeles and Orange Counties	1.00
Map No. 40—Elwood, Santa Barbara County	1.00
Map No. 41—Potrero, Los Angeles County	.75
Map No. 42—Playa del Rey, Los Angeles County	1.25
Map No. 43—Capitan, Santa Barbara County	.75
Map No. 44—Mesa, Santa Barbara County	1.25
Map No. 45—Buttonwillow gas, Kern County	.75
Map No. 46—Richfield, Orange County	1.00
Map No. 47—Mountain View, Kern County	.75
Map No. 48—Mountain View and Edison, Kern County	1.25

DETERMINATION OF MINERAL SAMPLES

Samples (limited to two at one time) of any mineral found in the State may be sent to the Division of Mines for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the State. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

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STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
GEORGE D. NORDENHOLT, Director

DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO

WALTER W. BRADLEY State Mineralogist

Vol. 31 OCTOBER, 1935 No. 4

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OF
MINES AND GEOLOGY

QUARTERLY CHAPTER
OF
STATE MINERALOGIST'S REPORT XXXI

STATE DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO
CALIFORNIA

28145

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TABLE OF CONTENTS

Page

Reports of District Mining Engineers 401

Redding Field District 401

Sacramento Field District 401

San Francisco Field District 402

Mines and Mineral Resources of San Luis Obispo County 402

Mineral Resources of Portions of Monterey and Kings Counties 462

Los Angeles Field District 465

Mining Activity at Soledad Mountain and Middle Buttes—Mojave Mining District, Kern County 465

Geologic Branch 486

Current Notes 486

Geology of a Portion of the Perris Block, Southern California 487

Mineral Resources of a Portion of the Perris Block, Riverside County, California 507

Oil Field Development Operations 522

Special Articles 526

Administrative 526

Minerals and Statistics 527

Statistics 527

Museum 530

Laboratory 531

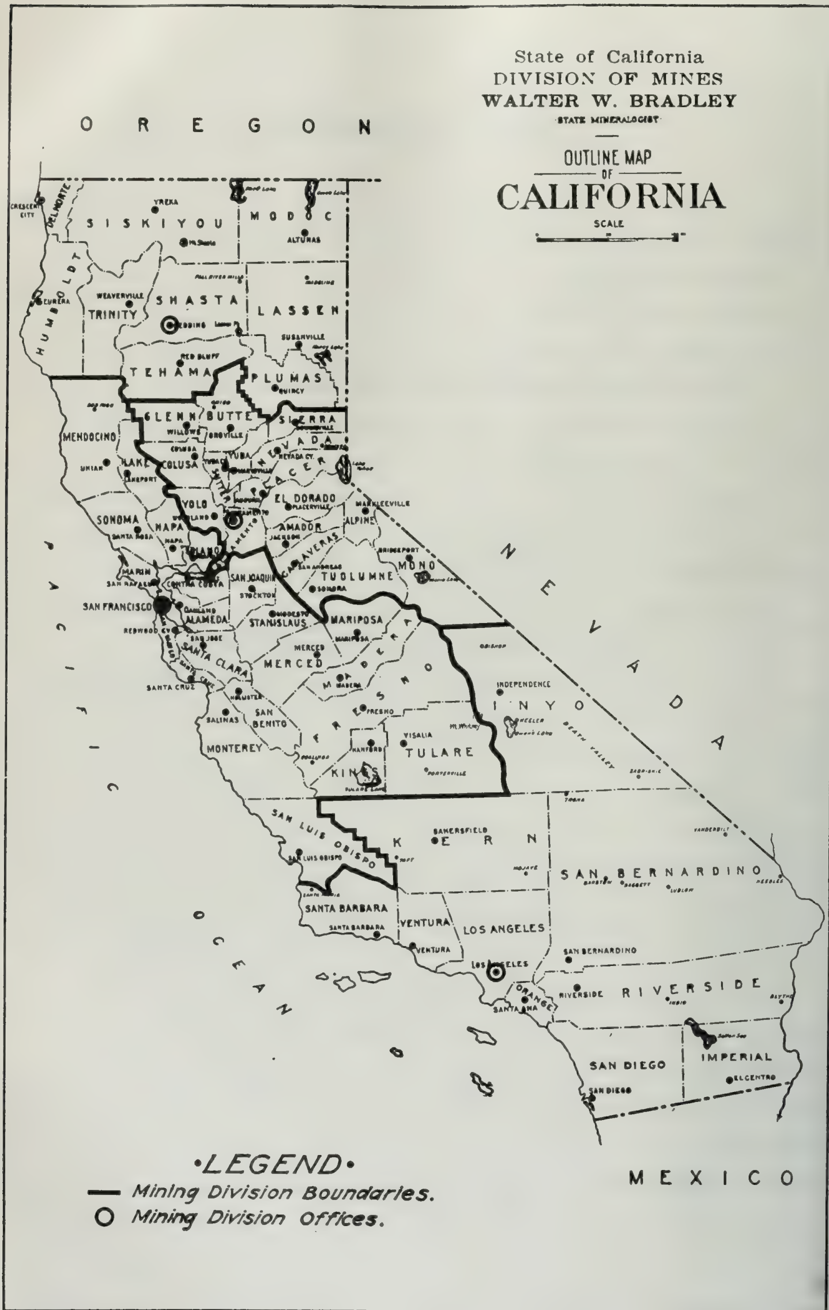
Library 533

Producers and Consumers 541

Employment Service 542

Publications 543

Index to Volume XXXI 557


State of California
DIVISION OF MINES
WALTER W. BRADLEY
STATE MINERALOGIST
OUTLINE MAP OF CALIFORNIA
SCALE
OREGON
NEVADA
MEXICO
PACIFIC OCEAN
SISKIYOU
MODOC
DEL NORTE
HUMBOLDT
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
GLENN
BUTTE
SIERRA
NEVADA
MENDOCINO
LAKE
COLUSA
YUBA
SUTTER
PLACER
YOLO
EL DORADO
ALPINE
SONOMA
NAPA
SACRAMENTO
AMADOR
SOLANO
MARIN
CONTRA COSTA
SAN JOAQUIN
CALAVERAS
TUOLUMNE
MONO
SAN FRANCISCO
ALAMEDA
STANISLAUS
MARIPOSA
SAN MATEO
SANTA CLARA
MERCED
MADERA
SANTA CRUZ
SAN BENITO
FRESNO
INYO
MONTEREY
TULARE
KINGS
SAN LUIS OBISPO
KERN
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
ORANGE
RIVERSIDE
SAN DIEGO
IMPERIAL
CRESCENT CITY
YREKA
Mt. Shasta
ALTURAS
WEAVERVILLE
EUREKA
REDDING
SUSANVILLE
RED BLUFF
QUINCY
WILLOWS
OROVILLE
UKIAH
LAKEPORT
NEVADA CY.
AUBURN
PLACERVILLE
MARKLEEVILLE
WOODLAND
JACKSON
SANTA ROSA
NAPA
BRIDGEPORT
SAN RAFAEL
STOCKTON
SAN ANDREAS
SONORA
OAKLAND
MODESTO
REDWOOD CY.
SAN JOSE
MERCED
MARIPOSA
MADERA
HOLLISTER
SALINAS
FRESNO
INDEPENDENCE
VISALIA
Mt. Whitney
HANFORD
PORTERVILLE
DEATH VALLEY
BAKERSFIELD
SAN LUIS OBISPO
MOJAVE
VANDERBILT
NEEDLES
BARSTOW
LUDLOW
SANTA MARIA
SANTA BARBARA
VENTURA
SAN BERNARDINO
LOS ANGELES
RIVERSIDE
INDIO
BLYTHE
SANTA ANA
Salton Sea
SAN DIEGO
EL CENTRO
•LEGEND•
Mining Division Boundaries.
Mining Division Offices.

PREFACE

The Division of Mines (formerly State Mining Bureau) is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

As a progressive step in advancing the interests of the mineral industry, and as permitting earlier distribution to the public, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923. Owing to a lack of funds for printing this was changed to a quarterly publication, beginning in September, 1923. For the same reason, beginning with the January, 1924, issue, it becomes necessary to charge a subscription price. This covers approximately the cost of printing.

Pages are numbered consecutively throughout the year and an index to the complete report is included annually in the closing number.

Beginning with the 1930 issues, the activities and progress of the Geologic Branch are recorded also in these quarterly chapters. The important part that geology plays in the economic development of our mineral resources is further recognized in the change of title from *Mining in California* to CALIFORNIA JOURNAL OF MINES AND GEOLOGY, beginning with the January, 1933, chapter.

While current activities of all descriptions are covered in these chapters, the practice of issuing from time to time technical reports on special subjects will be continued as well. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters are subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Division of Mines is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

Types of Reports

In general the reports presented in these chapters are grouped into three classes:

1. Mines and mineral resources of a given county (describing kind, character, distribution and extent of development).
2. Specific economic and industrial mineral products (listing and describing the resources over the entire State of a given mineral substance, e.g. feldspar).
3. Geological reports on specific areas (recording results and conclusions, with maps, derived from field studies; and tied in with economic possibilities, and developments).

REPORTS OF DISTRICT MINING ENGINEERS

In 1919–1920 the Mining Bureau was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district, working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively. This move brought the office into closer personal contact with operators, and it has many advantages over former methods of conducting field work, including lower traveling-expense bills for the Bureau's engineers. In 1923 the Redding and Auburn field offices were consolidated and moved to Sacramento.

The Redding office was reestablished in 1928, and the boundaries of each district adjusted. The counties now included in each of the four divisions and the locations of the branch offices are shown on the accompanying outline map of the State. (Frontispiece.)

Reports of mining activities and development in each district, prepared by the District Engineer, will continue to appear under the proper field division heading.

REDDING FIELD DISTRICT

CHAS. V. AVERILL, Mining Engineer

There is no report from the Redding Field Division. Mr. Chas. V. Averill, District Mining Engineer, is engaged on investigations for a special report upon the gold resources of Plumas County.

SACRAMENTO FIELD DISTRICT

C. A. LOGAN, Mining Engineer.

On account of unfinished field work, there is no report from the Sacramento Field District in this issue.

SAN FRANCISCO FIELD DISTRICT

HERBERT A. FRANKE, Junior Mining Engineer

MINES AND MINERAL RESOURCES OF SAN LUIS OBISPO COUNTY

Introduction.

San Luis Obispo County was one of the original twenty-seven counties created in California in 1850. However, the history of the county goes back to the early Spanish settlement and occupation of California. The Mission San Luis Obispo de Tolosa was founded in 1772, by Father Junipero Serra, and the village that grew up around it took the name of San Luis Obispo, which became the county seat. The north, east and south boundaries of the county were moved several times between 1851 and 1885, but with little change in area or general outline. The present boundaries were redefined in the Political Code of 1919.

Most of its acreage was formerly included in Spanish grants, whose dimensions were expressed in leagues, and many ranchos containing from ten to fifty thousand acres long remained intact. These large holdings have gradually been divided. The little public land remaining open for mining location lies mainly in the Santa Barbara National Forest. Most of the mining consists of the development and production of minerals found on privately-owned lands or mining claims previously located.

The coastal section of the county is chiefly a dairying and vegetable area. Much wheat is grown on the Carrizo Plains. A large acreage over the county is devoted to stock raising. The county's excellent climatic conditions and fine beaches attract tourists.

Geography and Transportation.

San Luis Obispo County borders on the Pacific Ocean and lies midway between San Francisco and Los Angeles. Monterey County bounds it on the north, Kern on the east and Santa Barbara on the south. It contains 3334 square miles and had a population of 29,617 in 1930.

The coast line of the Southern Pacific traverses the county from north to south. The railroad follows the Salinas Valley through Paso Robles and Santa Margarita, thence it crosses the Santa Lucia Range via Cuesta Pass, reaching San Luis Obispo at the foot of the grade, and continues south through Pismo along the ocean shore. The Pacific Coast Railroad (narrow gauge) connects Port San Luis with San Luis Obispo and continues to Santa Maria and other points in Santa Barbara County. Steamer service is available at Port San Luis.

The Pacific Coast highway passes through the county from north to south, paralleling the Southern Pacific Railroad much of the way. Numerous other paved and improved roads connect all important points in the county. The new scenic Roosevelt highway extending along the coast from Monterey to Morro Bay is expected to be opened for traffic in the summer of 1936.

There are two important marine loading-terminals belonging to the Union Oil Company and Standard Oil Company, which permit an outlet for much of the crude petroleum produced in the San Joaquin Valley and Coastal fields. The Union Oil Company's terminus is located at Avila on San Luis Bay. The Standard Oil Company's new terminus is at Estero Bay, and it is said to be one of the busiest oil-shipping points on the Pacific Coast, if not in the world. A new submarine line laid along the ocean floor has just been completed, diverging sufficiently from the old line so that their ends will be far enough apart to permit two tankers to load simultaneously. A new 1200-ft. pier carries a pipe line out into 25 ft. of water (low tide) where a hose is attached and run into deeper water. An anchored tanker lifts the submarine hose by means of a chain attached to a buoy and connects it to the ship's piping. A heating station and sixteen 125,000-barrel capacity steel storage-tanks are situated on the hills (700 ft. elevation) above the Estero loading-terminal, permitting delivery by gravity.

Topography.

The Coast Range mountains traverse the county from northwest to southeast. The three main ridges are the Santa Lucia, San Luis, and San Jose ranges. The Santa Lucia Mountains, the central and most prominent range, divides the county into two unequal provinces, the larger lying north and east of this barrier and the smaller south and west of it. The southwestern area is again divided into Los Osos, San Luis, Arroyo Grande, and Santa Maria valleys by lesser ridges, of which the San Luis Range, which terminates on the coast at Point Buchon and runs a little south of east until it unites with the Santa Lucia, is the most elevated. A line of buttes extends northwestward from south of the city of San Luis Obispo for about 16 miles, terminating in Morro Rock. They are the resistant remnants of intrusive dacite-granophyre[1] plugs. Northeast of the main Santa Lucia Range lie the upper Salinas River Basin and numerous smaller valleys. The broad San Jose Range, including La Panza Mountains and numerous spurs, occupies the area east of Salinas River. Near the source of the river this range unites with the Santa Lucia. Between these mountains and the Temblor Range in the southeast, which roughly forms the eastern boundary of the county, is the peculiar fault valley known as Carrizo Plain. This valley has no outlet, its scanty run-off draining to the center where Soda Lake has formed.

Geology.

The geology of the San Luis Quadrangle, covering that portion of the county from the southern boundary to latitude 35° 30′ N., and from the coast to longitude 120° 30′ W., has been described and mapped in U. S. Geological Survey Folio 101. The geology of the county in relation to its petroleum possibilities is described in State Mining

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[1] Fairbanks, H. W., U. S. Geol. Surv. Geol. Atlas, San Luis folio (No. 101), p. 6, 1904.

Bureau Bulletins No. 69 and No. 89. A folio of geologic maps accompanies Bulletin No. 69.

The general geology of the county as shown on the State Mining Bureau's geological map of the state, published in 1916, indicates that the Santa Lucia Range from San Luis Obispo northwestward to the northern boundary is made up of Franciscan rocks, including slates, cherts, limestones and sandstones, with much serpentine and many dikes and intrusions of deep-seated igneous rocks. On the flanks of the range are narrow belts of Cretaceous sandstones and shales. Southeast of San Luis Obispo the formations are mainly Tertiary marine sandstones and diatomaceous shales. Unconsolidated sands, gravels, and clays extend from Pismo to Santa Maria River and well up the valley of the Santa Maria. East of Santa Margarita there is a large area in which granite predominates. The balance of the county lying east and north of the Santa Lucia Range consists almost entirely of sedimentary rocks of Tertiary age, shales, sandstones, tuffs and gravels with an area of Quaternary sediments comprising Carrizo Plain.

Mineral Resources.

The principal developed mineral resources of San Luis Obispo County at the present time are: quicksilver, petroleum, brick, sandstone, miscellaneous stone, chromite, gold, volcanic tuff, mineral water and volcanic ash. There are many undeveloped resources, such as copper, asphalt, bituminous rock, oil shale, diatomaceous earth, coal, gypsum, iron, limestone, marble, onyx, sodium sulphate, antimony, asbestos, dolomite, barite, and magnesite. Perhaps some of the mineral deposits mentioned as undeveloped are of such character and size that they are not commercial, but on the other hand many are of economic grade, and some were producers in the past. Most of the deposits of commercial importance have had some development and this work is described or referred to in this report.

The county is known mainly for its quicksilver and chromite production. Limited amounts of gold have been produced, dating further back than 1882. Probably the largest bituminous sandstone deposits in the state are situated in the south and southwestern portions of the county. The Arroyo Grande oil field, near these bituminous sandstone deposits, produces some low-gravity petroleum. The iron ore deposits southwest of San Luis Obispo warrant serious consideration in relation to an iron and steel industry in the state. The mineral springs add much to the prosperity of the county. There are extensive deposits of diatomaceous earth and volcanic ash. Many varieties of stone, suitable for building purposes, are found here, including rhyolitic tuff, sandstone, granite, and onyx marble. The sodium sulphate deposit at Soda Lake is a valuable resource of the county and more active development is expected here soon.

The writer spent the first two weeks of July, 1935, in a resurvey of the mineral deposits of the county. He wishes to gratefully acknowledge the assistance rendered by the mine owners and operators, and others interested in the natural mineral resources of San Luis Obispo County.

The county's mineral production amounted to $138,453 in 1934, compared to a total value of $55,914 in 1933. The county's largest annual mineral output amounted to $858,689, in 1918, due mainly to the large production of chromite for war purposes. The total recorded production, from the earliest year for which figures are available, to and including 1934, are given in the following table.

MINERAL PRODUCTION OF

Year	Bituminous rock		Brick		Chromite		Gold,[3] value	Mineral water	
	Tons	Value	M	Value	Tons*	Value		Gallons	Value
1876 [3]									
1877									
1878									
1879									
1880					[2]17,030	$184,704			
1881					1,790	24,000			
1882							$5,000		
1883					5,558	99,200			
1884									
1885					670	8,880			
1886					980	13,140	9,164		
1887	36,000	$180,000			600	7,980	1,740		
1888	43,000	215,000			300	2,550	3,000		
1889					4,300	66,865	6,260		
1890					687	5,496	8,800		
1891					75	592	1,785		
1892							1,097		
1893							600		
1894	9,432	32,263			[4]800	10,500	1,200		
1895	6,354	17,600	750	$3,750	[4]700	6,650	3,000		
1896	5,113	11,464			[4]200	2,000	3,000		
1897	2,291	5,117					2,500	7,800	$1,960
1898	4,788	18,927	830	5,280			1,000	800	400
1899	10,818	40,288	650	3,500					
1900	3,346	12,905	500	4,000					
1901	9,472	33,070	650	5,200			300	24,000	6,000
1902	1,790	2,327	900	7,650			2,399	4,500	800
1903	3,365	7,572	750	6,000			1,840		
1904							630	4,000	1,000
1905	2,533	6,348	400	3,200			300		
1906	2,533	6,644	300	2,400					
1907	2,167	8,128	2,000	16,000			316	4,800	1,000
1908	5,077	21,875	1,440	12,900				4,800	1,056
1909	2,731	6,369	2,245	19,605				4,000	1,000
1910	1,982	4,016	900	8,000				6,000	1,600
1911	2,710	5,230	2,000	18,000				2,000	1,000
1912	807	1,472						2,500	625
1913	609	1,149	1,750	17,500			124	1,500	600
1914	579	1,118						1,000	250
1915	[6]				[6]			4,500	675
1916	[6]		4,150	45,500	1,855	27,733		2,500	475
1917	[6]		[6]		4,109	92,846		1,500	300
1918	[6]				10,443	539,423	[6]	[6]	
1919	[6]				1,158	26,431			
1920					399	10,440			
1921					[6]			[6]	
1922					[6]			[6]	
1923					[6]			[6]	
1924			2,033	35,987				[6]	
1925			[6]		[6]		840	[6]	

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* Copper was weighed in tons of 2,360 pounds and chromite in tons of 2,240 pounds, but here converted to 2,000 pounds.

[1] The total production of asphaltum up to 1894 was reported as 800 barrels. This production reduced to tons is shown under 1894.

[2] Although a great deal of chromic iron ore was mined and marketed during the '70's, there are no records of yearly production. The above figure for 1880 represents the total shipments from San Luis Obispo up to August, 1880.

[3] There are no records of annual mineral production for the period of 1865-1876, but there was a small annual gold production from shallow placers before this, and these placers have no doubt yielded considerable gold never reported. The same observation applies to a number of small quicksilver properties worked in the '70's.

[4] Concentrates.

[5] Includes crushed rock, rubble, sand, gravel; also granite and sandstone prior to 1915

[6] See under 'Unapportioned.'

SAN LUIS OBISPO COUNTY, 1876-1934

Petroleum		Quicksilver[3]		Miscellaneous stone[5], value	Miscellaneous and unapportioned		
Barrels	Value	Flasks	Value		Amount	Value	Substance
----------	----------	6,428	$282,832	----------	*236,000 lbs.	$7,287	Copper.
----------	----------	3,310	123,463	----------	----------	----------	
----------	----------	2,151	70,768	----------	----------	----------	
----------	----------	779	2,358	----------	----------	----------	
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----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	$8,772	[1]220 tons 500 cu. ft.	4,400 20,000	Asphaltum (rock). Cal. onyx.
----------	----------	20	800	45,520	400 cu. ft.	4,000	Cal. onyx.
----------	----------	101	3,400	17,407	----------	----------	
----------	----------	101	3,939	13,500	238 cu. ft.	1,000	Cal. onyx.
----------	----------	384	11,660	47,000	----------	----------	
----------	----------	394	17,700	6,740	16 tons	320	Asphaltum (rock).
----------	----------	515	23,886	44,835	----------	----------	
----------	----------	840	41,513	----------	2,000 tons	30,000	Asphaltum (rock).
----------	----------	3,312	147,215	----------	4,000 tons	40,000	Asphaltum (rock).
----------	----------	4,577	183,530	58,374	100 bbls.	100	Lime.
----------	----------	†4,746	176,616	81,000	----------	----------	
----------	----------	3,733	133,748	46,000	----------	----------	
----------	----------	3,511	128,152	35,500	----------	----------	
48,127	$16,845	2,509	95,743	3,000	6,000 tons 300 bbls.	90,000 600	Asphaltum (rock). Lime.
10,000	5,000	867	36,648	900	----------	----------	
30,000	15,000	317	15,510	400	4,500 tons ----------	55,000 218,205	Asphaltum (rock). Unapportioned, 1900-1909.
22,310	11,155	563	25,476	75	13,000 tons	165,000	Asphaltum (rock).
38,092	25,146	569	26,180	----------	----------	----------	
2,129	1,469	666	27,998	----------	----------	----------	
----------	----------	1,160	46,667	134	----------	----------	
----------	----------	1,266	62,097	----------	----------	----------	
----------	----------	1,473	125,542	99,475	----------	1,940	Bituminous rock, chromite.
11,670	5,252	1,227	114,724	49,318	356 lbs. ----------	88 2,717	Copper. Bituminous rock, pottery clay, sandstone.
74,143	68,656	1,565	151,034	8,422	----------	16,886	Bituminous rock, brick, manganese, soda.
62,744	56,783	[6]	----------	6,100	1,907 tons ----------	81,926 174,447	Manganese ore. Bituminous rock, copper, gold, mineral water, quicksilver, silver, soda.
31,656	32,922	[6]	----------	20,300	----------	132,777	Bituminous rock, manganese, quicksilver, sandstone, soda.
42,511	59,515	1,224	89,186	[6]	----------	246,463	Copper, granite, manganese, soda, miscellaneous stone.
30,725	43,691	----------	----------	80,000	----------	6,100	Chromite, diatomaceous earth, mineral water.
33,856	31,892	----------	----------	107,000	----------	2,578	Chromite, diatomaceous earth, mineral water.
32,988	19,793	----------	----------	46,479	----------	78,977	Chromite, diatomaceous earth, mineral water, quicksilver, soda (salt cake).
31,222	30,972	[6]	----------	113,384	----------	137,436	Mineral water, natural gas, quicksilver, sodium sulphate.
29,590	32,164	[6]	----------	50,113	---------- ----------	7 53,353	Silver. Brick, chromite, mineral water, natural gas, quicksilver, sodium sulphate.

† Flasks of 76½ pounds previous to June, 1904; of 75 pounds thence, through 1927; of 76 pounds since January, 1928.

MINERAL PRODUCTION OF

Year	Bituminous rock		Brick		Chromite		Gold, value	Mineral water	
	Tons	Value	M	Value	Tons*	Value		Gallons	Value
1926	----------	----------	----------	----------	[6]	----------	----------	[6]	----------
1927	----------	----------	----------	----------	----------	----------	----------	----------	----------
1928	----------	----------	[6]	----------	[6]	----------	$725	[6]	----------
1929	----------	----------	----------	$31,320	[6]	----------	1,267	[6]	----------
1930	----------	----------	[6]	----------	[6]	----------	1,461	[6]	----------
1931	----------	----------	[6]	----------	----------	----------	1,549	[6]	----------
1932	----------	----------	----------	----------	----------	----------	1,021	[6]	----------
1933	----------	----------	[6]	----------	[6]	----------	759	[6]	----------
1934	----------	----------	[6]	----------	[6]	----------	1,946	[6]	----------
Totals	[6]157,497	$638,882	[6]	$245,792	[6]51,653	$1,129,430	$63,623	[6]76,200	$18,74

[6] See under 'unapportioned.'

[7] Includes chromite, granite (tuff), marble, mineral water, petroleum, volcanic ash.

[8] Includes brick and building tile, chromite, clay (pottery), granite (tuff), marble, mineral water, petroleum, volcanic ash

[9] Includes brick and building tile, granite (tuff), mineral water, volcanic ash, sandstone.

[10] Includes brick, chromite, mineral water, petroleum, volcanic ash, miscellaneous stone.

[11] Includes brick, granite (tuff), mineral water, volcanic ash, chromite, petroleum, sandstone.

SAN LUIS OBISPO COUNTY, 1876-1934—Continued

Petroleum		Quicksilver		Miscellaneous stone[5], value	Miscellaneous and unapportioned		
Barrels	Value	Flasks	Value		Amount	Value	Substance
27,982	$22,162	----------	----------	$193,138	----------	$22,914	Clay and clay products.
					----------	15,080	Chromite, mineral water, natural gas, quicksilver.
16,709	12,531	470	$53,600	195,631	----------	33,268	Brick, building tile (hollow), copper, mineral water, pumice.
15,140	12,869	435	48,254	111,181	2 fine oz.	1	Silver.
					----------	44,095	Brick, building tile, chromite, mineral water.
[6]	----------	1,076	120,995	11,061	2 fine oz.	1	Silver.
					----------	26,440	Other minerals.[7]
[6]	----------	1,306	157,440	28,659	3 fine oz.	1	Silver.
					----------	60,554	Other minerals.[8]
53,349	29,342	2,574	202,870	150,016	2 fine oz.	1	Silver.
					----------	16,357	Other minerals.[9]
					3 fine oz.	1	Silver.
66,744	36,709	2,035	106,508	105,075	----------	616	Mineral water, volcanic ash, sandstone.
[6]	----------	285	15,759	[6]	----------	39,396	Other minerals.[10]
[6]	----------	1,302	91,677	11,860	8 fine oz.	5	Silver.
					----------	32,965	Other minerals.[11]
675,687	$569,868	57,791	$2,965,488	$1,796,369	----------	$1,863,362	

MINES

ANTIMONY

Marquat Estate Deposit. Stibnite, sulphide of antimony, occurs in the SW¼ of SW¼ of Sec. 2, T. 27 S., R. 9 E., near the head of San Simeon Creek, about ten miles east of Cambria. A quartzitic vein, three feet in width, with about one foot of stibnite on the footwall, was uncovered on the property in 1886. The vein is in Franciscan sandstone. It strikes NE. and dips 70° NW. A former report states that an analysis of low-grade ore taken at random from the surface croppings showed 18.3% antimony. One shipment of ore was made many years ago, and some prospecting was done at this locality during the World War. Nothing has been done recently. It is owned by the Marquat Estate, San Luis Obispo, and is now rented to John Marquat, Cambria.

Bibl: State Mineralogist's Report X, p. 579; XV, p. 676; XXI, p. 504; State Min. Bureau Bull. 91, p. 29.

ASBESTOS

Asbestos of uncertain quality and in unknown amount is said to occur in the mountains between Pozo and Hasbroucks (near Musick), northeast of Arroyo Grande. A shipment is said to have been made from here many years ago, but the fiber was of such short length that the product did not bring profitable return.

Bibl: State Mineralogist's Report XXI, p. 504.

ASPHALT

Natural asphalt was formerly used a good deal in this state for paving, and San Luis Obispo was a considerable producer of it. Of late years, however, the natural product has been displaced by the material yielded in crude-oil distillation, as the latter is more uniform in quality and more cheaply obtained.

The principal natural deposits were on Tar Spring Creek, 9 miles east of Arroyo Grande, and in the bituminous rock area near Edna. There has been no output of natural asphalt from either locality for many years.

Bibl: State Mineralogist's Reports VII, p. 97; XII, p. 30; XV, p. 676; XXI, 504. U. S. G. S. XXII Annual Report, Part I, p. 412; Mineral Resources 1883–1884.

BARITE

A deposit of barium ~~carbo~~nate is reported to occur on the Fugler Ranch, 6 miles southeast of Arroyo Grande, in the Nipomo township. The ledge is said to be from 1 to 2 ft. wide. Undeveloped. S. Fugler, Santa Maria, owner.

BITUMINOUS ROCK

Sands of the Pismo and Santa Margarita formations which have been saturated with and cemented together by natural asphalt are of widespread occurrences in San Luis Obispo County. The asphalt comes from the underlying Monterey shales; and when it seeps up into the overlying sand, it changes the latter into a tough weather-resisting stratum.

The principal deposits of the county occur between the towns of Edna and Pismo, on the north portion of the old Arroyo Grande oil field. These bituminous sand deposits cover approximately two square miles, and are said to be the largest in the State of California. Many of these deposits were quarried years ago before oil asphalt replaced bituminous rock in highway paving. Most of this development was in the vicinity of Edna, about six miles south of San Luis Obispo. Other quarries were operated along and near San Luis Bay, near the town of Arroyo Grande, and on Tar Spring Creek, 9 miles east of Arroyo Grande, where natural asphalt was also refined years ago.

An attempt was made to mine these oil sands in 1922 for their oil content by flotation methods, but apparently it was not found to be economical as the project was soon abandoned. This attempt is mentioned in Report XVIII of the State Mineralogist, pages 273–275. Report XIX of the State Mineralogist, pages 211–224, contains an article on the oil shales of Santa Barbara County, with details of methods to treat same, assuming that the oil produced would be used as a flotation oil.

All of the bituminous rock quarries in San Luis Obispo County have been idle for many years.

Bibl: State Mineralogist's Reports VII, pp. 53, 97–99; VIII, p. 533; X, p. 571; XII, p. 29; XIII, p. 37; XV, pp. 83–85; XXI, pp. 504–505. U. S. Geol. Survey, San Luis Folio 101.

CHROMITE

Chromic iron ore is next in importance to quicksilver in the mineral resources of San Luis Obispo County. Production, dating back to the seventies, has varied considerably in accordance with the market demand and price. The county's output reached its peak in 1918, when 10,443 tons was shipped. The market collapsed the latter part of 1918, after the declaration of peace in Europe, and chrome mining fell off rapidly. Some small shipments of chrome ore have been made from the county in the past few years.

The chromite deposits are hard black ore mixed with serpentine and grading into the surrounding serpentine. The ore occurs mainly as lenses or kidneys, and in some mines these lenses are connected by stringers of low-grade ore. A report entitled "Some Chromite Deposits in Western and Central California" in U. S. Geological Survey Bulletin 430, by E. C. Harder, states:

> "Many of the deposits occur in the serpentine near the contact of older rocks into which the serpentine has been intruded. Such rocks may surround serpentine areas or may occur as masses within the serpentine. Hence deposits may be found extending around the borders of serpentine areas or may occur near included older rock masses within serpentine areas. Other deposits apparently have no such connection with older rocks and are scattered through the serpentine. In many of the areas the included rock masses are fine-grained biotite schist, and locally chromite deposits are found along their contacts."

The serpentine areas, of Franciscan and Knoxville age, in which the chromite deposits occur, are irregular and of varying size. The principal chrome deposits of the county are in the Santa Lucia Range four to nine miles north of San Luis Obispo, and in the Los Osos Mountains, southwest of San Luis Obispo. Other small deposits occur along the Santa Lucia Range northwesterly into Monterey County.

Previous reports give a more detailed description of the various chrome mines than is necessary herein. The reader is therefore referred to the bibliography at the end of this chapter, if further details are desired.

Buena Vista and Red Wing; Good and Manzanita; Old Gold, Last Chance, and Banana Chrome Claims. These 7 claims are situated near the Sweetwater chrome mine, about seven miles northeast of Morro Bay. Assessment work is kept up by the respective owners, Fred Pierce, Feree Pierce, and Karl Pierce, all of Morro Bay.

Castro Extension Mine, adjoining the Castro mine. Much of the small production of chrome ore in San Luis Obispo County in the last few years has come from this property. Fred Pierce worked the property in 1934, shipping about 200 tons of 37% chrome ore. It is owned by Mrs. Grace R. Arata, 1028 Chorro Street, San Luis Obispo.

Castro Mine. This patented property is situated in the east half of Sec. 29, T. 29 S., R. 12 E., six miles northwest of San Luis Obispo. It has been a large producer and was equipped with a 50-ton concentrating mill during the World War. Ore of 20% to 25% Cr_2O_3 was concentrated. The property is now idle and is owned by the Alfred A. Wheeler Estate, 1640 Clay Street, San Francisco.

Chorro Creek, Single Jack, and Santa Clara. Chorro Creek, No. 1, 2 and 3 claims adjoin the Pick and Shovel mine, and are situated in Sec. 34, T. 29 S., R. 12 E. The Single Jack claim is also located in Sec. 34, T. 29 S., R. 12 E. The Santa Clara, from which some chrome ore has been produced in the last few years, is in Sec. 33, T. 29 S., R. 12 E. Mrs. Grace R. Arata, 1028 Chorro Street, San Luis Obispo, owner.

El Divisadero and El Salto Chrome Mines. The mineral rights to these adjoining properties, in Sec. 33, T. 29 S., R. 12 E., are owned by the L. H. Butcher Co., 15th and Vermont Streets, San Francisco. Idle.

Evans Ranch Deposit. In Sec. 2, T. 25 S., R. 6 E., on W. J. Evans Ranch. Idle.

Fitzhugh Ranch Deposit. It is located 12 miles east of Cambria. Some chrome ore was shipped from this property during the World War; and several tons are reported as remaining on the dump. An old tunnel, about 150 ft long, worked during the war, is now caved in. Wm. Fitzhugh and son, Cambria, owners. Idle.

Froom Estate. Situated in Sec. 8, T. 31 S., R. 12 E., on Laguna Rancho Grant. Idle.

Johe Ranch Deposit. Located in Sec. 2, T. 31 S., R. 11 E. Idle.

La Primea and La Trinidad Chrome Mines. These mines are reported to have been good producers in the past, but are now idle. The mineral rights to this property, 180 acres, situated in Sec. 33, T. 29 S., R. 12 E., are owned by the L. H. Butcher Co., 15th and Vermont Streets, San Francisco.

London (New London) Chrome Mine. This property is situated in the SW¼ of the SE¼ of Sec. 33, T. 29 S., R. 12 E., six miles northwest of San Luis Obispo. Mrs. Grace R. Arata, 1028 Chorro Street, San Luis Obispo, owner. This mine has been fairly well developed, and when operation ceased in 1918 extensive ore reserves are said to have been left blocked out. About 3500 tons of ore was shipped from the property during the war period. The ore lenses have a general northwest strike and a uniform dip of about 60° NE. The ore was reported to average 38% Cr_2O_3 and 8% to 10% SiO_2. A map of the underground workings and developed orebodies is shown opposite page 508 in the October issue of State Mineralogist's Report XXI, 1925, and on page 172 in Bulletin 76, ''Manganese and Chromium in California,'' 1918.

Middlemast Chrome Deposit, on the W. C. Middlemast Ranch, is in Sec. 25, T. 28 S., R. 10 E. Idle.

Nigger Head, Mescal, Eureka and Old Town Claims. These claims are held jointly by Mrs. Grace R. Arata, 1028 Chorro Street, San Luis Obispo, and Walter W. Pierce, Morro Bay. The Nigger Head mine, situated in Sec. 32, T. 29 S., R. 12 E., has produced a small amount of chrome ore in the past few years. The Mescal claim lies mainly in Sec. 29, T. 29 S., R. 12 E. The Eureka and Old Town claims are situated near the Sweetwater Group.

Pereira Group, Rancho Piedra Blanca. These two properties upon which chrome ore occurs, are included in the land holdings of Wm. R. Hearst. The Pereira Group is in T. 25 S., R. 8 E., while the other deposit (undeveloped) is in Sec. 4, T. 25 S., R. 7 E. Idle.

Pick and Shovel Mine (also called *Safety Chrome Mine*). This property comprising 83.2 acres in the SE. ¼ of Sec. 34, and the SW. ¼ of Sec. 35, T. 29 S., R. 12 E., is located four miles north of San Luis Obispo on the western slope of the Santa Lucia Range. This property was worked more extensively in the early days than any other chromite mine in the district, producing a large tonnage between 1880 and 1890. Over 4000 tons of high-grade ore was produced from the mine during the World War. Small shipments have been made from the property since the market collapsed in 1918. O. H. Wolmer drove a 300-ft. tunnel on the property in 1929 and 1930 in search of a new orebody, which he failed to find, but did mine and ship a small tonnage of ore. The ore occurs in lenses and stringers in a crushed zone. The chromite is found impregnating the serpentine as well as in almost pure masses. An analysis of ore from the lower drift, made in 1917, showed 51.45% Cr_2O_3 and 1.44% SiO_2. The silica content usually averages a little more than this. Mrs. Grace R. Arata, 1028 Chorro Street, San Luis Obispo, owner. A map of the underground workings of this mine is shown on page 509 in the October issue of State Mineralogist's Report XXI, 1925. It is said that operations may be resumed at this property soon.

Pine Mountain Group (Chisholm). This property, belonging to the Wm. R. Hearst holdings, is in Secs. 3 and 10, T. 26 S., R. 8 E. About 400 tons of good chromite was produced here in the eighties. Now idle.

Rancho Santa Manuela. Chromite has been found on this property, six miles northeast of Arroyo Grande.

Rancho Santa Rita. Some chromite was shipped from a deposit on this ranch in the eighties. It is eight miles northeast of Cayucos. Idle.

Russ Deposit. Chrome ore occurs on this ranch, located in Sec. 4, T. 25 S., R. 6 E. Idle.

San Bernardo Creek Deposit. F. Miranda, Victoria Street, and Henry C. Dalessi, 1125 Olive Street, both of San Luis Obispo, owners, have just commenced to work this deposit. They plan to run a series of open cuts. This property, situated in T. 29 S., R. 11 E., near the headwaters of San Bernardo Creek, has had a small production of chrome in the past.

Sweetwater Chrome Group. This property is situated mainly in Sec. 12, T. 29 S., R. 11 E., about seven miles northeast of Morro Bay, on the Morro-Atascadero Road. It has been a good producer of high-grade ore in the past. About 50 tons of chromite were produced in 1934. Kidneys of chromite have been developed at different points on a well-defined fissure in the serpentine. The fissure strikes N. 60° W., with a dip of 60° to the NE. Some of the ore runs 45% Cr_2O_3 and 8% SiO_2.

A 6-ton concentrating plant, built in 1928 and 1929, is situated on the property. Waste and overburden carrying 15% to 20% Cr_2O_3 have been treated at various times for the past three years. The coarse material from the grizzly is crushed to $\frac{1}{2}$-inch to 1-inch size by a small jaw crusher, driven by a 10-h.p. gasoline engine. This product is fed into a Chili ball mill, where the material is crushed through a 20- to 30-mesh screen for a 45% to 49% concentrate, or through a 10-mesh screen for a 40% to 42% Cr_2O_3 concentrate. The crushed material then goes to an Overstrum Universal Concentrator. The chromium concentrates are shipped to steel mills in Los Angeles and Torrance. A sand and settling tank are used to furnish water for the milling operations, because of the scant natural water supply. Three men are employed when the plant is in operation. The Sweetwater mine and concentrating plant are owned by Walter W. Pierce, Morro Bay, and Mrs. Grace R. Arata, 1028 Chorro Street, San Luis Obispo.

Welsh Ranch Deposit. A small lens of chromite occurs on this ranch, situated in Sec. 4, T. 31 S., R. 11 E. Mrs. Lyda F. Welsh, 1314 Palm St., San Luis Obispo, owner. Idle.

The Alviso and Sunshine Claims, located in Sec. 34, T. 29 S., R. 12 E.; *Colorado Chrome Mine,* in Sec. 32, T. 29 S., R. 12 E.; *Cypress*

Chrome Mine, in Sec. 34, T. 29 S., R. 12 E.; *Lucky Jack Group,* in Secs. 29 and 31, T. 29 S., R. 12 E.; *Mutual Chrome Mine,* in Sec. 35, T. 29 S., R. 12 E.; *Norcross Chrome Mine,* in Sec. 13, T. 29 S., R. 11 E.; *San Carpojaro Creek and Arroyo La Cruz Deposits,* in Sec. 12, T. 25 S., R. 7 E., have all apparently been abandoned.

Bibl: (On chromite in San Luis Obispo County): State Mineralogist's Report XV, pp. 674–726; XXI, pp. 507–10; State Mining Bureau Bulletin 76, pp. 103–104, 167–178. U. S. Geological Survey Bull. 430, pp. 168–173, 181–182; San Luis Folio 101.

CLAY

According to our Bulletin 99, entitled, 'The Clay Resources and the Ceramic Industry of California,' there are no known deposits of high-grade clays in this county, but red-burning clays suitable for making brick occur in the valley silts of recent origin at various places. Since the population of the county is small, the demand for clay products is limited, and a single common-brick plant at San Luis Obispo supplies the market of the county as well as of a few nearby towns in Santa Barbara and Monterey counties. The territory to the south is supplied by brick yards in Santa Barbara, while plants in San Jose furnish brick for the communities in Santa Clara, Monterey, and San Benito Counties.

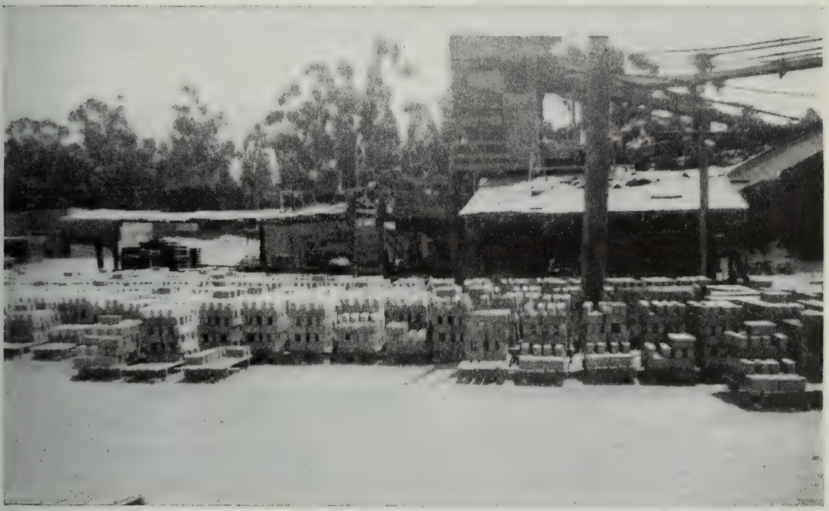


FIG. 1. Plant of San Luis Brick Works, San Luis Obispo.

There is an extensive undeveloped deposit of red-burning shale two miles south of Santa Margarita that would be suited for the manufacture of vitrified red-burned structural ware.

San Luis Brick Works (formerly *San Luis Brick Co.*). This property is owned and operated by Faulstick Bros., San Luis Obispo. The plant is located one mile south of town near the lines of the Southern Pacific and Pacific Coast railroads. The clay used is a yellowish loam, with little or no overburden. The proportion of sand is sufficient to prevent excessive shrinkage and cracking in the brick-making process, yet is not so high as to interfere with the binding properties of the clay. The clay is mined to a depth of 15 ft. by power scrapers, which are hauled up an incline by an electrically-driven winch, and dumped through a hopper into a 10-ft. dry pan. After screening, the fines pass to a pug mill, then to an American Clay Machinery's auger machine equipped with a Steele Cutter. The oversize from the screen is returned to the dry pan.

The bricks are dried in the open without auxiliary heat. This requires an average of three weeks. Burning is done in open field-kilns, usually with 18 arches, each kiln containing 590,000 brick. Natural gas is used for heating. Firing requires five days, and cooling about three weeks. About 1,500,000 bricks were made in 1930, and the plant had not been in operation since then until June, 1935. When the property was visited in July, 1935, six men were employed making brick and hollow building tile. Twenty-eight men are employed when in full operation.

Bibl: State Mineralogist's Report XIV, pp. 679–680; XXI, pp. 505–506. State Division of Mines Bull. 99, pp. 213–214, 327.

Antelope Mud Co. This company commenced mining a rotary-drilling mud in the spring of 1935, in Sec. 22, T. 25 S., R. 16 E., about 3 miles east of Cholame. W. G. Angus, Box 204, Lost Hills, California, is the lessee of 320 acres of the land, which is owned by the R. E. Jack Co., Inc., San Luis Obispo. A drag-line is used to remove the overburden and to mine the clay. The heavy dark clay material is loaded on trucks and taken to the pulverizing plant. A dry-pan pulverizer, driven by a gasoline engine, is used to grind the clay. This clay, to which a high-specific gravity mineral such as barite is sometimes added, is much in demand for rotary-drilling mud in the nearby oil fields of the San Joaquin Valley, where it is hauled by truck. Four men are employed when in operation.

COAL

Some coal is reported to have been mined in this county in the early days. One coal outcropping, two feet in width, and usually covered with water at high tide, is on the beach at San Simeon. Another small seam, not over 15 inches thick, occurs on Pico Creek, about four miles from the beach, on the Piedra Blanca Grant. A small coal seam also occurs on the coast on the Rotanzi Ranch, six miles north of Cayucos. Coal is also reported to have been found between Pozo and Hasbroucks.

Probably none of these coal deposits is of commercial importance.

Bibl: State Mineralogist's Report VI, p. 118; VIII, p. 532; XII, p. 61; XXI, p. 510.

COPPER

Several small bodies of high-grade copper ore and surface indications of more extensive deposits of low-grade orebodies occur throughout the serpentine areas of this county. The principal mineralization is in the Santa Lucia Range, north and northwest of San Luis Obispo, and in the Los Osos Hills.

Some copper mining claims were located in the sixties, and a few shipments of copper ore made to Swansea, Wales. The ores usually carry small values of gold and silver. Chalcopyrite and malachite are the most common ores found, although occasionally native copper is disseminated through the serpentine.

Most of the properties are quite inaccessible. A few of them were being worked by local men over the week-ends and holidays when the county was visited. Bulletin 50, 'Copper Resources of California,' 1908, and State Mineralogist's Report XV, 1915–1916, describe most of these copper prospects. An attempt was made to connect the history of the various properties, but in many cases the owners were unable to enlighten the author, since there have been so many abandonments, changes in names and ownerships, relocations, and long periods of idleness.

Little Bend, Florence, The Barbara Claims. These claims have just been located near the San Ramon group, about six miles northeast of Morro Rock. It is necessary to go over a trail for the last mile and a half to reach them. E. C. Sevier, Arroyo Grande, owner.

There are several other claims in this vicinity. Some of them are named: *Bonanza, Alpha, Big Bend, Lucky Jack*, and *North Star.* Howard Sevier, Lompoc, W. A. Sevier and R. A. Sevier, both of Arroyo Grande, are the owners of these claims. The ore is essentially copper, with traces of gold and silver.

Lone Star and Fern Mine, formerly *Silver Swan.* These two claims, located eight miles east of Cuyacos, near the headwaters of Morro and Toro creeks, are owned by Mrs. Maude Terris, 1421 Park St., Paso Robles, and W. R. Kester. There is a 300-foot tunnel on the property from which some copper ore was produced in the past. The annual assessment work has always been completed on the property, except for the past four years, when the owners took advantage of the moratorium in regard to assessment work.

Bibl: State Mineralogist's Report XV, p. 686; XXI, p. 511.

Los Osos Mine. This property is eight miles southwest of San Luis Obispo, on the south side of Los Osos Valley. The mine was located in 1864. One hundred tons of 18% copper ore was shipped from it to Swansea, Wales, in the early days.

Ogden Chase leased the property in 1934, cleaned out the two tunnels and shaft, and then abandoned the project. He had four men working at the time. The vein, 4 to 12 ft. in width, was developed by a shaft 230 ft. deep. The lower tunnel, 235 ft. long, was used to drain water from the mine. A mill erected on the property during the early days has been entirely dismantled. The mine is located on property mainly owned by Mrs. E. Filipponi, 1223 Higuera St., San Luis Obispo, and Joe A. Silva.

Bibl: State Mineralogist's Report XV, p. 686; XXI, p. 511; State Min. Bur. Bull. 50, pp. 172–173.

Ridge Claim. It is located between Toro and Old creeks, about 8 miles due east of Cayucos. S. E. Hogue, 1506 Chorro Street, San Luis Obispo, and Ray C. Hogue, the owners, have opened a 20-ft. open cut, 10 ft. deep, on the claim. The owners state that an assay of the ore showed 6.28 oz. silver, 0.02 oz. gold, 0.98% nickel, and a trace of copper. An adjoining claim, called the *"Take a Chance,"* is owned by S. E. Hogue and Harold Hogue.

San Ramon No. 1, 2, 3 and 4. These claims, situated between Morro and Toro creeks, five miles northeast of Morro Rock, were formerly worked by W. K. Hobson. It is said that No. 1 claim was first located in 1860, when Ramon Felis worked it and sent the ore to Spain. The claims lie in a serpentine belt at an elevation of about 1500 ft. The hanging wall is said to be sandstone and the footwall porphyry. Besides copper, the ore is said to carry $3.60 in gold and 38 cents in silver. Present development work consists of a 140-ft. tunnel being driven to crosscut a ledge reported to be 5 to 11 ft. wide. The vein strikes NW.-SE. An old 50-ft. shaft is now partly caved in. An average of ten men work on the claims every week-end and holiday. G. W. Hampton, 712 Marsh St., San Luis Obispo, Fred Felis, and Paul Dallidet are the owners.

Skyscraper Mine, formerly *First Chance.* This property is located about eight miles east of Cayucos, on upper Toro Creek, near the Lone Star and Fern claims. Besides surface workings, the development consists of two tunnels in 180 ft. and 50 ft. A vein reported to be 10 ft. wide, carrying chalcopyrite, was tapped in the development. The ore is reported to carry 4.8% copper, 1.34% nickel, and a trace of gold and silver. S. E. Hogue, 1506 Chorro St., San Luis Obispo, owner, works on the property intermittently.

Bibl: State Mineralogist's Report XV, p. 686; XXI, pp. 511–512; State Mining Bureau Bull. 50, p. 173.

Yoakum Tract. A 350-ft. inclined double-compartment shaft was sunk on a hillside, located on the Yoakum Tract, two miles south of San Luis Obispo, off the road to Edna, by Ogden Chase. This new prospect was commenced in February, 1934, and apparently much money was spent before the project was abandoned in November, 1934. The author was unable to obtain much information on the prospect, but the ore is said to have shown traces of gold and silver and about one-half on 1% copper. From 5 to 20 men are reported to have been employed on a three-shift basis during part of the period of development. The three pumps and hoist with which the property is said to have been equipped have now been removed. Reports also state that the ground was diamond drilled 700 ft. from the bottom of the shaft. No ore was treated or shipped. Jesse Yoakum, San Luis Obispo, is owner of the land.

Other copper claims and their locations, that have been filed on in the county at one time or another, and now probably abandoned, are:

Guerro, Guadalupe, Gloria, Tassajara and *Tiptop* claims in T. 29 S., R. 12 E.

Refugio claim, on Chorro Creek, seven miles north of San Luis Obispo.

Prodigal Son, six miles east of Cayucos, between Toro and Old creeks.

Schneider and McCles claim, seven miles east of Morro, on San Bernardo creek.

Take-a-Chance Group, near the summit of the Santa Lucia Range, four to seven miles south and west of Santa Margarita.

DIATOMACEOUS EARTH

Extensive deposits of white, chalk-like beds of diatomite or infusorial earth are found widely distributed throughout the Coast Range in Monterey, San Luis Obispo, and Santa Barbara counties. These deposits are mainly composed of the siliceous skeletons of countless marine diatoms, which are microscopic, single-celled plants.

The San Luis Obispo County deposits occur in the Pismo, Santa Margarita, and Monterey formations. Some deposits are better than others, containing less sand and clay. Most of the occurrences are near Arroyo Grande, Edna, Port Hartford, south of Morro Bay, in the mountains back of Pismo, in the hills south of the San Luis Valley, and in the Salinas Valley.

Ferrell Deposit. This diatomite deposit is a continuation of the former Incello Company's deposit, and it is situated on Los Osos Creek, south of Morro Bay. The bed is 45 ft. thick. C. E. Ferrell, P. O. Box 156, San Luis Obispo, owner.

Bibl: State Mineralogist's Report XXI, p. 512.

Los Peñascos Ranch Deposit. This deposit of cream-colored diatomaceous earth is located 3 miles north of Pismo. Undeveloped. Hazzard Gragg, R. F. D. No. 1, Box 58, San Luis Obispo, owner.

Bibl: State Mineralogist's Report XXI, p. 512.

Thompson Reid Estate (formerly *The Incello Company, U. S. Refractories Company*). This large diatomite deposit is situated on the south side of Los Osos Valley, 2 miles south of Morro Bay and 10 miles west of San Luis Obispo, the nearest railroad shipping point. The diatomite beds dip steeply to the north and are said not to be as thinly laminated as those at Lompoc. Outcroppings of this diatomite ridge are exposed at various intervals for over a mile. The deposit is said to be somewhat gritty in places and often contains small sand streaks. The deposit reverted back to the original owners, the Thompson Reid Estate, 1306 Higuera Street, San Luis Obispo, when the Incello Company ceased operating.

The Incello Company, which absorbed the U. S. Refractories Company, operated the deposit and a plant in San Luis Obispo, where they pulverized, bonded, and baked the diatomite into insulating bricks several years ago. From the main highway they built a planked road over the low sand dunes for one-half mile to the diatomite deposit, but this road is now in bad condition. The Clyde hoist, tramway and loading equipment formerly used have now been removed from the property and the deposit is idle. Most of the equipment at the brick plant, located adjacent to the Southern Pacific and Pacific Coast Railroad lines, near the end of Broad Street, San Luis Obispo, has been removed except for two round 30-foot bee-hive type down-draft kilns. Probably more than 70,000 insulating bricks remain at the brick plant and are for sale. These bricks and the plant site are now owned by W. M. Hollister, Fred Garret, and Mrs. Grace Arata of San Luis Obispo.

Bibl: State Mineralogist's Report XXI, p. 512. Canada Department of Mines Bulletin 691, pp. 100–101.

Bibl: Besides the references given heretofore on diatomaceous earth, the reader is referred to: State Mineralogist's Reports X, p. 583; XV, p. 688; State Mining Bur. Bull. 38, p. 293. U. S. Geological Survey San Luis Folio 101; Bull. 315. Diatomaceous Earth, by Robert Calvert.

DOLOMITE

S. Aumaier, whose address is reported Los Angeles, formerly had a deposit of white dolomite located in Sec. 13, T. 30 S., R. 13 E., at the upper end of Little Falls Canyon, a branch of Lopez Canyon, and about 15 miles northeast of Arroyo Grande. It is accessible by trail only. An analysis of a sample as given in State Mineralogist's Report XXI, p. 513, is as folows:

SiO_2	0.40%
Al_2O_3	0.19
Fe_2O_3	0.05
CaO	31.70
MgO	20.44
Loss on ignition	47.36
	100.14

GOLD

It is said that at least $100,000 in gold was produced in San Luis Obispo County in the early days. However, the county can not be considered as one of the gold-producing counties of the state, although gold was probably mined here before 1848. Traditions say that the missionary fathers obtained large quantities of gold, silver, and lead from mines within the county, but there is no evidence of such rich mines.

No doubt most of this early production came from the small streams on the eastern slope of the San Jose Range draining into San Juan River in the vicinity of La Panza. Two hundred and fifty people are reported to have been mining gold in this area for a few years in the early days, each making from $2 to $4 per day. This early mining of gold-bearing gravel was by means of pans and rockers, and some sluices. In 1934, $1,946 in gold was produced from placer mining in this county.

Some placer mining has also been done on the western slope of the granitic San Jose Range (Pozo Range), along creeks emptying into the Salinas River. San Marcos Creek, west of Paso Robles, was worked, as well as a number of streams on the west slope of the main Santa Lucia Range in the northwestern portion of the county.

State Mining Bureau Bulletin 92, published in 1923, makes the following comment, on page 153:

> "While the Coast Range in the Franciscan rocks has never been productive of any great concentration of gold, nevertheless there have been numerous local enrichments in which extraction has been attempted at various times by placer miners. In San Luis Obispo County is an area of Franciscan metamorphics which has thrown some gold into the tributaries of Poso Creek, but not in any great quantity. Attempts have been made to work this by steam shovel and by mechanical elevation. At Fraser Canyon and near La Panza are considerable areas of gravel but they are low-grade and extremely spotty. Thus far no economic success has attended any work done in this district in spite of the fact that there is plenty of water available for working. The gold is exceedingly flaky and fine and the district is very spotty."

There are no quartz mines in the county, although an attempt was made many years ago to mine quartz gold five miles west of San Luis Obispo by the Cuesta Gold Mining and Milling Company. Veins of quartz in the granitic areas are apparently the source of the placer gold, though there seem to be but few and they are small. However, there has been little exploration for the source of the placer gold. A possible explanation of the scarcity of gold-bearing veins is probably due to the erosion of most of them during the geologic history of the area. At least the gold placers of the area will bear investigation, for values of the gravels tested sometimes run from 25 cents to $2.00 per cubic yard. An economic geological survey should be made of the sedimentary folds that abut the granite in La Panza district. It is said that one particular gravel stratum can be traced for miles, carrying good gold values. Other gravel strata, however, are barren or show only a trace of gold. The auriferous gravels in the creek beds appear to have received most of their enrichment from the sedimentary strata.

The beach sands of the county have been worked for gold in the past.

Morning Star Placer Mining Co. This company is out of existence, and its claims in Secs. 6, 7, 8, 17, 18, 19 and 20 of T. 30 S., R. 17 E., have been abandoned. Bill Saylor is said to have done some prospecting on this ground recently.

Navajo Mines. Bert Alley, Poso P. O., owns considerable gold-bearing gravel ground on Navajo and McGinnis creeks, which he claims will average about 60¢ per cubic yard. With the aid of his three sons, he does a little hydraulicking here every winter, recovering a few hundred dollars in gold.

Mr. Alley believes that it would be possible to operate a small dredge or dragline dredge on the auriferous gravels, based on his estimate that approximately a million yards are available. He states that about one and a half miles of stream bed 100 yards in width could be dredged. The average depth to bedrock varies from 12 ft. upstream to 23 ft. downstream. Sufficient water could be reached at a depth of about 12 ft.

Queen Bee Mine. This property consists of approximately 200 acres on Mineral Creek, west of La Panza. The deposit is composed of uncemented gravel of medium size with an average depth of 12 ft. The bedrock is granite. Values occur from the surface down and are fairly evenly distributed. The gold is coarse and somewhat rough, and small nuggets are occasionally found. It is said that jewelers and dentists greatly desire this gold because of its high-grade quality.

No one could be found at the property when the visit was made in July, 1935, although someone seemed to be living at the mine camp. A portable gold-washing plant was noted in the nearby creek-bed. It consisted of a hopper through which the gravel was fed into a revolving trommel, with screens driven by a Ford engine. The fine gravel discharges through the screens and is then run down a sluice box, while the coarse cobbles pass through the lower end of the trommel to a conveyor belt which stacks the rocks behind. All of this equipment is mounted on a Peerless motor chassis. The gravel is mined and lifted to the hopper by a Universal power shovel, mounted on a Fordson tractor. This shovel is driven by special gears attached to the tractor engine. Apparently operations had stopped because of the lack of water. It is said that operations are to continue at this property and that a water supply will be developed. A stationary gravel-washing plant, fed by a long conveyor belt, was apparently operated on the property several years ago. Most of its equipment has been dismantled. Henry Chester, 5701 York Blvd., Los Angeles, or Pozo, California, the present owner, has owned this property since 1896.

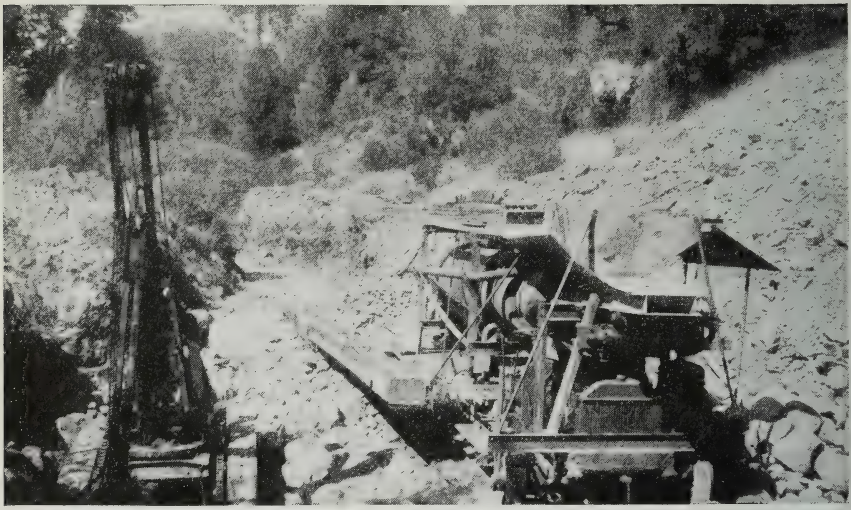


FIG. 2. Portable gold-gravel washing plant and Universal power shovel, Queen Bee Mine, San Luis Obispo County.

Placer Creek Operations (formerly *O. S. Still Ranch Property*). Considerable acreage on this property in Secs. 30 & 31, T. 29 S., R. 16 E., at La Panza, is considered to be good mining ground. The elder Mr. Still came into this region over 55 years ago and engaged in placer mining with several hundred other Americans, Mexicans, and Chinese. O. S. Still acquired the ground after much of the richer surface placers were worked out and abandoned. The property was worked on a small scale at various times during his ownership. Lack of water for working has hampered operations in recent years. Mrs. Berma S. MacLean, La Panza, is the present owner.

Fred Edrman, No. 5 Vera Court, Redwood City, and associates commenced to operate this property in May, 1932, using a high-line bucket. An 80-ft. cut, 6 ft. deep, was made into the gravel, which is said to have run 15 to 20 cents per cu. yd. This party constructed a dam to impound water for its operation. The dam burst in July, 1932, and operations ceased until April, 1935. A negligible production of gold was realized from the 1932 operations.

A test operation was made on the property in the spring of 1935. A "V" bucket dragline, one cu. yd. capacity, with hoist driven by gasoline engine, was used to make a 90-ft. cut, 8 ft. deep to bed-rock. This gravel in the creek bed was said to average about 25 cents per cu. yd. A 50-ft sluice box, equipped with Brussels carpet, burlap, herringbone cloth, and 2-inch riffles set 2 ft. apart was used to recover the values. Water was pumped from the trench made in the creek bottom.

Raymond Owens, 1001 Claus Spreckels Bldg., San Francisco, has made an agreement with three other interested parties who hope to commence operations on the property this fall. A consulting mining engineer conservatively estimated that three million cubic yards of auriferous gravel is available, averaging 25 cents or better per cubic yard. It is difficult to make an estimate of yardage and values because the economic geology has yet to be worked out.

Frasier Canyon is located at the foot of Pozo Mountain, four miles east of Pozo. Some placer mining is done here during the winter months when water is available.

S. P. Dayton Ranch, H. V. Underwood, Hollister, and E. A. Mathews are installing a pump, engine, sluices, and pipes on this property, located on the Nacimiento River, near the San Luis Obispo-Monterey county line. They plan to work the river gravels for their gold content as soon as water is available.

Bibl: State Mineralogist's Reports VIII, p. 530; X, p. 578; XII, p. 243; XIII, p. 348; XV, pp. 687–688; XXI, pp. 514–515; State Mining Bureau Bulletin 92, p. 153.

GYPSUM

No commercial deposits of gypsum have as yet been developed. It occurs, however, in limited quantity as white bunches and veins on Alamo Creek, 16 miles from Santa Maria, and in the form of alabaster at Arroyo Grande. Gypsite, an impure form, is found in beds on the southwest side of the Temblor Range, east of Carrizo Plain, and crystals of selenite occur in the clays along Carrizo Creek.

Bibl: State Mineralogist's Report XXI, p. 515; State Mining Bur. Bull. 91, p. 271.

IRON

An extensive iron-ore deposit is located in the San Luis Range, in that part known as the Los Osos or Irish Hills, mainly within the Rancho Cañada de Los Osos y La Laguna, and within the drainage of Prefumo and Andrews canyons and Clark Valley. The easternmost outcrop of the deposit, once known as the *McKinney Iron Mines,* lies about two and one-half miles a little south of west of San Luis Obispo, and the westernmost outcrop is about four miles from the Pacific Ocean. A map of the area, topography, and number of veins, as indicated by their outcrop, accompanies State Mineralogist's Report XXI.

W. McKinney and associates of San Luis Obispo were instrumental in uniting the mineral rights as one unit in 1924, by consent of the various ownerships and interests belonging to these iron-ore deposits. The combined properties presented a strong argument for the establishment of a plant for an iron and steel industry here. Their idea was to have a plant established consisting either of blast furnaces, using petroleum fuel in the direct reduction of iron, or a combination process using low-grade fuel, such as lignite or petroleum by-products in the production of sponge-iron, and electric smelting of the sponge. A former Californian corporation, called the Wakama Iron and Steel Co., carried on a great deal of experimental work with a process of the latter character, under the supervision of Smith Emery and Company. The process entirely eliminated the need of coke and permitted the direct production of steel from iron ore by the use of fuel oil and its by-products. It is described in detail in State Mineralogist's Report XXI, pp. 515 to 518. This report also contains analyses of samples taken from the various veins. Analyses previously published of the limonite show an average of 46.1% iron, 13.2% silica, 6% lime, 0.63% sulphur, and 0.51% phosphorus. The hematite is said to be of higher quality, running about 50% iron.

All of the mineral rights to the iron properties of this area have now reverted to their original owners. Lots 37, 38, 73 and 74 of the Rancho Cañada de Los Osos y La Laguna belong to Mrs. Lyda F. Welsh, 1314 Palm street, San Luis Obispo. Lots 39, 40, 48, 70, 71 and 72 were also included in the former McKinney Iron Mines holdings. No attempt was made to ascertain the present owners of all this ground. Mrs. Ada S. Prefumo, 742 Pacific street, San Luis Obispo, still retains the mineral rights on her former property in Prefumo Canyon. George J. Johe, San Luis Obispo, is also owner of much land in this vicinity.

The iron-ore deposits occur as laminated veins in the Franciscan shales and ferruginous sandstones, often near or at the contact with olivine diabase. It has been said that the deposits are replacements of chert by massive limonite, but again it may be the deposition from the weathering of ferruginous sedimentary rocks and of igneous rocks rich in iron. The ore is brittle and has suffered fracturing during the recent intense deformation of the area. Both hematite and limonite ore occur. The iron-ore veins have been traced by outcrops in a general direction of N. 80° W. for a distance of approximately 5½ miles. Some of the outcrops are offset from the general strike of the lode and the deposits may be somewhat disconnected. The veins on the eastern half converge along the south slope of Johe Hill, probably the most favorable place for the development of tonnage. These veins apparently have been somewhat disturbed by igneous intrusions. Limonite is prevalent in the eastern portion of the deposit. Farther west, above the old Goodwill Copper Mine, the formations are also disturbed, and the veins badly shattered. A 30-ft. exposure of hematite ore occurs here. It is said that the veins from this point westward and across Clark Valley are, in the main, hematite.

The depth to which this deposit extends is problematical because there has been little development work done. A former report states that there is only positive evidence of continuation at depth at one point where a crosscut has intersected the ore at a depth of 150 ft. below the surface, but that outcrops are found in place at points having a difference in elevation of nearly 1200 ft.

It would appear that a large tonnage of iron ore is present and the deposit is worthy of development. It is situated near tide water and in the coastal region of California, midway between San Francisco and Los Angeles. The deposit is accessible several ways by good roads, and the topography and distance are such that a railroad line could be extended to the place at a low cost. Other favorable factors are the property's proximity to electric power, crude-oil pipe lines, and to natural deposits of accessory minerals utilized in the iron industry.

Bibl: State Mineralogist's Reports XV, pp. 688–689; XXI, pp. 515–522. State Mining Bur. Bull. 38, p. 301; U. S. Geol. Survey San Luis Folio 101; Bull. 430, pp. 220–223.

LIMESTONE

Quite a number of commercial limestone deposits are to be found in this county. Few of these deposits have been utilized because of the limited local demand and their distance from transportation. A few carloads of limestone have been shipped in recent years for use in sugar refining.

The limestones occur mainly in the Monterey formation in both the Santa Lucia and San Luis ranges. Deposits have been noted: in Secs. 18 and 19, T. 26 S., R. 10 E., and some was burned here years ago; in the northwestern part of T. 32 S., R. 16 E., and eastern part of T. 32 S., R. 15 E., and in Sec. 36, T. 32 S., R. 14 E. There is an immense bed of fossil clam and oyster shells near the Oceanic Quicksilver Mine. Limestone has been burned in the past on the Newsom Estate near Newsom Springs. Another unexploited deposit occurs two or three miles north of Santa Margarita.

Limestone Mountain. Walter B. Roselip, 615 Grand Ave., San Luis Obispo, shipped a carload of limestone from this deposit, located in Sec. 15, T. 26 S., R. 9 E., to the Spreckels Sugar Company in 1933. It is said that more limestone was quarried here for use in sugar refining at a later date. Charles Taylor, Salinas, is owner.

Lopez Canyon Group. Considerable limestone outcrops several hundred feet above Lopez Canyon Creek in the high ridge on the south side of the Canyon, and is exposed at several points along its strike, which is northwest, and parallel with the canyon. The limestone bed dips about 45° SW. into the ridge. A thickness of 100 ft. or more is exposed at the junction of Fern Canyon and Lopez Canyon. Several thinner limestone beds outcrop at various elevations on both sides of the canyon.

Three claims were located at the corner common to T. 30 S., R. 13 E.; T. 30 S., R. 14 E.; and T. 31 S., R. 13 E.; T. 31 S., R. 14 E.; northeast of Arroyo Grande, in the Santa Barbara National Forest in 1924. No definite information in regard to the present status of these claims was obtainable, but S. Aumaier, now in Los Angeles, and S. J. Rhyne, are said to be the owners. Lime that was well-burned in a small home-made kiln erected several years ago slaked rapidly and completely.

Tassajara Group. These three claims are in Secs. 21 and 28, T. 29 S., R. 12 E., 4½ miles west of Santa Margarita. S. Aumaier is said to own these claims. The deposits consist of a white, coarsely crystallized calcite, situated on the eastern slope of the Santa Lucia Range near the summit, at the head of Tassajera Creek. A road goes up Tassajera Creek within a short distance of the property. Several roads on the west side of the ridge extend as far as the chrome mines in the serpentine area, which cuts off the calcite veins on the south. Several veins have been exposed on the claims by short open cuts, the largest vein having a width of 12 to 14 ft. An analysis of the calcite made by Smith, Emery and Co. several years ago showed the following composition:

SiO_2	0.45%
Al_2O_3	0.19
Fe_2O_3	0.85
Mn_3O_4	0.80
CaO	54.24
MgO	0.42
Loss on ignition	43.40
Total	100.35

The sample is unusual in having an appreciable manganese content.

MAGNESITE

Magnesite is reported to occur on the *Kiser Ranch,* nine miles northwest of Cambria; and on the *Steele Ranch,* in the Huasna district seven miles east of Arroyo Grande. The latter deposit, although undeveloped, is said to be of considerable size.

Bibl: State Mineralogist's Report XXI, p. 523; State Mining Bureau Bull. 91, p. 133; U. S. Geol. Survey Bull. 355, p. 38.

MANGANESE

Small deposits of manganese ore occur in the county, in lenses of chert in the Franciscan area which traverses Los Osos Mountains, west of San Luis Obispo. Chert lenses, in which there are some small manganese deposits, are also of frequent occurrence throughout the Franciscan belt, which strikes northwest across the entire county on the west slope of the Santa Lucia Range.

The manganese occurs as oxides, both hard and soft, but apparently the best of the ore is largely psilomelane near the surface, and hausmannite at greater depth. It occurs in seams and irregular masses in the Franciscan chert or jasper. Analyses of ore from the mines vary, but some of the past assays indicated ore carrying from 37% to 56% manganese, with silica content from 1½% to 8%.

Several thousand tons of manganese ore was produced in San Luis Obispo County during the World War period; but there has been no recent production here. All of the properties have been described in detail in Bulletin No. 76, "Manganese and Chromium in California," and so are but briefly referred to in this report.

Evans Deposit. Two manganese prospects occur on the W. and J. Evans Ranch, northwest of San Simeon. One of these outcroppings is in Sec. 3, T. 25 S., R. 6 E.

Hearst Ranch. There is a deposit on the Hearst Ranch, on San Simeon Creek, three miles from the wharf at San Simeon.

Johe Deposit. This deposit, owned by George J. Johe, San Luis Obispo, is at the head of Clark Valley, in the Los Osos Hills, seven miles west of San Luis Obispo. It is undeveloped.

Dante Muscio, 793 Buchon St., San Luis Obispo, has a manganese deposit near Cayucos, from which there has been a small output.

Phelan Ranch Deposits. Prominent manganese outcroppings are found in T. 27 S., R. 8 E., in the Pine Mountain District, eight miles from Cambria. R. & Jeff Phelan, Cambria, owners.

Riccioli Prospect. This deposit is seven miles southwest of Cambria and ¼ mile from the road between Cayucos and Cambria. It is owned by the Riccioli Estate, Cayucos.

Serrano Deposit. Manganese occurs on the property owned by Don Carlos Serrano, P. O. Box 125, San Luis Obispo, located in Clark Valley seven miles west of San Luis Obispo. Undeveloped.

Staneuch Ranch Deposit. This property is situated south of Clark Valley in the Prefumo Canyon district, eight miles by road southwest of San Luis Obispo. This deposit was under lease to the Manganese Co. of California during the war period, and was one of the principal producers of the county. It was developed by several tunnels and open cuts. The property is now said to be in litigation.

Welsh Ranch Deposits. High-grade ore was produced from these deposits during the war period. The manganese deposits are mainly located in Lot 74 of the Rancho Cañada de Los Osos y La Laguna on the ridge south of Clark Valley, about nine miles west of San Luis Obispo. Mrs. Lyda F. Welsh, 1314 Palm street, San Luis Obispo, owner.

Bibl: State Mineralogist's Report XII, p. 330; XV, pp. 689–690; XXI, pp. 523–524. State Mining Bur. Bull. 76, pp. 14–15, 69–74; U. S. Geol. Survey San Luis Folio 101; Bull. 427.

MINERAL WATER

San Luis Obispo County has a great number of mineral springs and wells, both hot and cold, having a wide variety of chemical salts in solution. They occur in various places in the county, but the better known and most improved springs and resorts are in the southwestern part and in and around Paso Robles. Some of these springs are considered to have medicinal qualities, and are used for drinking and bathing.

Bitterwater Spring is one of several small springs in the southern part of Carrizo Plain. It is a watering place for livestock.

Cameta Warm Spring is located 30 miles southeast of Paso Robles. It has a small flow with a temperature of 74° F. and has been used to some extent for bathing.

Grand Central Sulphur Spring is in reality a 510-ft. well, which has been capped and not utilized in any way for a decade. It is located on property formerly owned by the Frank Sparks Estate, near the center of Paso Robles.

R. C. Heaton Well. This well is situated on what was at one time a part of the James Property, which included the Paso Robles Springs Hotel site. The tract containing the Heaton well is at 10th and Spring Streets and comprises a city block, with the exception of one lot, adjoining the hotel grounds. Grace E. Heaton, Paso Robles, owner.

The well was drilled about 30 years ago and a large flow of mineral water, similar to that at the hotel springs, was developed. The well is 230 ft. in depth double-cased and cemented to a depth of 120 ft. The water has a temperature of 106° F. and is under a heavy hydraulic head. If permitted to flow freely it is estimated that it would run 500,000 gallons per day. There is an eight-room cement bath-house, with cement tubs, sunk in the ground, for the owner's and tenants' use, but only a comparatively small part of the flow is utilized. The water is not bottled nor sold.

A cool spring is situated on the R. C. Heaton Ranch in the Oak Flat district, 4 miles northwest of Paso Robles. This water is used for irrigation and domestic purposes.

Hesemeyer Estate. This well is located on the east side of Salinas River about 2½ miles north of Paso Robles, on the property of E. Hesemeyer. The well was originally drilled for irrigation purposes, but the mineralized water was not suitable and is not now used for any purpose. The well is said to be 500 ft. deep and the temperature of the water approximately 98° F. The following analysis was made by Smith, Emery and Company in November, 1928:

“INDUSTRIAL ANALYSIS

“Analysis of solids:	*Grains per U. S. gallon*
Suspended matter	
Silica (SiO_2	2.52
Iron oxide and alumina (R_2O_3)	.05
Lime (CaO)	.29
Magnesia (MgO)	.08
Soda (Na_2O)	37.14
Sulphuric Anhydride (SO_3)	9.40
Chlorine (Cl)	11.39
Carbon Dioxide (combined) (CO_2)	14.45
Volatile and organic matter	4.07
Total	79.39
Excess oxygen	2.57
Total solids	76.82
Hydrogen sulphide (H_2S)	
Carbon dioxide (half bound) (CO_2)	
Carbon dioxide (combined) (CO_2)	

Incrusting solids	*Grains per U. S. gallon*
Suspended matter	
Silica	2.52
Iron oxide and alumina	.05
Calcium carbonate	.52
Calcium sulphate	None
Calcium chloride	None
Magnesium carbonate	.09
Magnesium chloride	None
	3.18
Sodium carbonate	34.14
Magnesium sulphate	.12
Sodium sulphate	16.53
Sodium chloride	18.78
Volatile and organic	4.07
Total	73.64

“NOTE.—This water is not suitable for irrigation. The total solids are too high in any case. The chief fault, however, is the character of the total solids. They consist very largely of black alkali (sodium carbonate) and white alkali (sodium sulphate). Should not be used on any soil to which value is attached.”

Huer-Huero Springs. Two groups of mineral springs occur on the Huer-Huero Ranch, located about 15 miles southeast of Paso Robles and 1½ and 3 miles, respectively, south of Creston. The small flow of water is cold and strongly sulphureted.

Kessler Springs, are located at the Kessler Mexican Onyx Deposit and are noted because of the deposit of travertine which has formed about them. The flow is small and has a temperature of about 60° F. The water is not utilized. The ‘onyx deposit’ is described under the heading ‘Onyx Marble.’

Merry Hill Mineral Well is located on a hill about ¼ mile west of Paso Robles. The well is 170 ft. deep, and has a very small flow, as the water is pumped out in about five minutes, but fills up again immediately. The small output is put up in gallon bottles and sold locally. Mrs. F. L. Merckel, Paso Robles, is owner. An analysis made at the University of California quite a number of years ago shows:

	Gr./gal.	*Parts/ 10,000*
Potassium sulphate Sodium sulphate	5.39	.93
Sodium chloride	4.77	.81
Sodium carbonate	1.23	.21
Calcium and magnesium carbonate Calcium sulphate	17.52	3.00
Silica	.88	.15
Organic matter and chemicals Combined water	6.13	1.05
Totals	35.92	6.15

Municipal Baths Springs, in Paso Robles, is an artesian well, 392 feet deep, having a flow reported to be 380,000 gallons per 24 hours. Hot sulphur water issues at a temperature of 108.6° F. and is utilized in a very substantial and well-appointed municipal bathing pavilion.

Newsom's Springs are located 2½ miles east of Arroyo Grande in T. 32 S., R. 13 E. They have been owned by the Newsom Estate since 1864, and the water, which contains iron and sulphur, was used by the Indians before that time for medicinal purposes. Former reports state that the spring yielded about 15 gallons of water per minute at a temperature of 100.5° F. Small cottages and bathing facilities surround the spring.

Ontario Springs (formerly *Budan Springs*). This spring is in reality an artesian well brought in during 1908 while boring for oil. The water comes up from a 3-inch pipe and has a temperature of 178° F., considerably higher than any other spring or well in the district. There are tub baths and a large outdoor plunge. The water is markedly sulphurated. Ontario Springs is located on the Coast highway, six miles south of San Luis Obispo, and is a popular swimming and bathing resort. Mrs. F. Budan, San Luis Obispo, is owner and manager.

New Crystal Spring Water Co., W. R. Hudson, Route 2, Box 11, San Luis Obispo, owner. Two cool-water springs, located on a hillside two miles south of San Luis Obispo, off the Edna road, have been utilized by the present company since 1927. The water is piped down to a bottling plant by gravity, where it is put up in five-gallon bottles for distribution over the county. Two men are employed. From 150 to 200 gallons of mineral water are produced daily. The following analysis is supplied by the company:

	Grains per gallon
Sodium chloride	1.56
Sodium sulphate	.79
Sodium bicarbonate	.15
Magnesium bicarbonate	4.31
Calcium bicarbonate	3.84
Alumina	.23
Iron oxide	.51
Total	11.39

Paso Robles Hot Springs is one of California's most noted and popular pleasure and health resorts. The property is equipped with a large hotel and bath house, completely equipped for the entertainment of guests and the treatment of ailments for which the mineral waters are recommended. There is a large plunge and varied equipment with skilled operators, who administer hot-air and vapor baths, massage, exercises and other treatment to supplement the use of the water. The resort occupies a spacious site in Paso Robles, facing the Coast highway. The so-called main sulphur spring is an artesian well, 640 ft. deep with a 10-inch casing, which has an enormous flow of hot sulphureted water. The temperature of the water is 107.6° F. and the flow is stated to be 2,000,000 gallons per day.

Paso Robles Mud Bath Springs are operated under the management of Dr. G. W. Tape, who is also manager of the Paso Robles Hot Springs described above. The Anglo American Realty Co., Sansome and

Market Streets, San Francisco, are the owners. The mud baths are situated 2½ miles north of Paso Robles on the edge of Salinas River. The bath house here is equipped with packing rooms and concrete basins built into the mud springs. There is a constant ebullition of gases and mineral water through the mud. The sulphur and radioactive properties of the mud are said to be especially beneficial toward the curing of some ailments. The temperature of the water varies from 104° to 122° F. and it is markedly different in mineral content from that at the Paso Robles Springs proper. Adjacent to the mud baths is a 4-inch well, 140 ft. deep, called the Lithium Spring, yielding water having a temperature of 118° F. This water is used for drinking. A natural spring called the Soda Spring, is situated a few yards away. It has a temperature of 77°. Water from this spring was formerly artificially carbonated and bottled by the Paso Robles Soda Works. The Iron Spring is another small spring with a temperature of 64°, containing a little more iron than the others; utilized for drinking.

Pecho Warm Springs consists of several small springs west of San Luis Obispo in Islay Creek, two miles from the ocean. Two springs of the group have a temperature of 95° and 72° F.

San Luis Hot Springs (formerly *Sycamore Springs*). This well is situated six miles south of San Luis Obispo and ¼ mile from the Coast highway on the road to Avila. The hotel, cottages, and other accommodations, which were formerly operated as a resort, are now occupied by the State Emergency Relief Administration Transient Division. The property is controlled by the receivers of the Federal Farm Loan.

A large flow of hot sulphur water, having a temperature of 110° F., with a considerable quantity of gas, issues from the well and is used for bathing in plunges and tubs. The following analysis is posted at the property:

Sulphureted H. gas	6.40
Free carbonic acid gas	14.06
Sulphate lime	4.02
Peroxide magnesia	1.44
Silica	1.60
Bicarb. magnesia	6.40
Arsenic	.06
Sulphur	12.00
Sodium chloride	9.02
Iodine and bromides	.07
Peroxide iron	4.10
Bicarbonate of soda	21.00

Santa Ysabel Springs are located four miles southeast of Paso Robles. The larger of two springs had a flow of about 220,000 gallons and a temperature of 94° F. The bathhouse is said to have crumbled in and very little use is now made of the water.

Sulphur Spring. A spring of warm sulphur water rises near the banks of Tassajera Creek, about two miles west of the Coast highway opposite the foot of Cuesta grade on the Santa Margarita side. It flows about 15 gallons per minute, and is unimproved. Situated on the property of Gustave Renkert.

Superior Spring Water Co. This cool-water spring, located on a hillside on the Yoakum Tract, about 1½ miles south of San Luis Obispo off the Edna road, was developed about 1930. The water is piped down by gravity to a small bottling plant. Frank Sweeney, Route 2, Box 5, San Luis Obispo, is owner and bottler. The following analysis is given by the company:

Sodium (Na) (by calc.)	21
Calcium (Ca)	28
Magnesium (Mg)	60
Sulphate (SO_4)	24
Chloride (Ci)	71
Carbonate (CO_3)	—
Bicarbonate (HCO_3)	289
Silica (SiO_2)	13
Iron and aluminum as oxides	0
Suspended matter	0
Total (by addition)	506

Quite a number of small, cold springs are utilized as drinking fountains in the northwestern portion of the county along the new scenic Roosevelt highway, from Monterey to Morro Bay.

Another cold mineral spring is situated in Sec. 26, T. 26 S., R. 11 E., on the right-hand side of the road from Paso Robles to Adelaide. It is not utilized.

Bibl: State Mineralogist's Report XV, pp. 690–697; XXI, pp. 524–527, U. S. Geol. Survey Water-Supply Paper 338. Anderson, Winslow, M.D., ''Mineral Springs and Health Resorts of California,'' 1892; Fitch, William E., M.D., ''Mineral Waters of the U. S. and American Spas,'' 1927.

MOLDING SAND

Guiton Molding Sand. Dunes of very fine beach sand are being marketed as a molding sand at Oceano. This sand is trucked to the railroad spur of the Southern Pacific at Oceano for shipment. Three or four men are employed when working. Harold E. Guiton, Oceano, is owner.

OIL SHALE

An oil shale belt strikes east-west across T. 26 S., R. 10 E. There is a good exposure three miles west of Adelaide in the bed of Las Tablas Creek, which cuts across it at right angles. The shale stratum is practically horizontal, being 10° or less dip, on the property of H. T. Ramage in Secs. 19 and 20. It is exposed for one-half mile, along the creek, but its thickness at right angles to the bedding plane has not been determined. A sample from a cut about 2 ft. in depth in the creek bed, taken several years ago and sent to the laboratory of the Union Oil Co. is reported to have yielded 8⅓ gallons of 16.5° Baumé gravity oil to the ton. Material taken at some point distant from the creek bed and at greater depth would probably show a higher yield.

Bibl: State Mineralogist's Report XXI, p. 528.

ONYX MARBLE

Kessler Deposit. One of the largest and finest onyx marble deposits in the state is located in Secs. 9 and 16, T. 31 S., R. 15 E., five miles north of Musick and about 17 miles northeast of Arroyo Grande. There are two patented mining claims surrounded by other land holdings of the Kessler Estate. This 'onyx marble,' or Mexican onyx, is a variety of calcite, resembling true onyx. Mineralogically, it is either aragonite or travertine. The deposit is the result of the deposition from mineral springs.

It was opened in 1890, and during the nineties it is said that more than 1000 tons was shipped out, most of it going to the eastern states. The face of the quarry was 50 ft. long, 20 ft. high and a thickness of 15 ft. of material was exposed. The onyx marble occurs in layers from 1 inch to 8 or 10 inches in thickness, and at one point 30 inches. It is white, also banded and variegated or sometimes marked with red blotches. Some portions are banded with dark green color. The stone is translucent and takes an excellent polish. Blocks 3 to 6 ft. square have been taken out and larger ones could be obtained by careful quarrying. There has been no production for many years.

Bibl: State Mineralogist's Report XXI, p. 527; State Mining Bur. Bull. 37, p. 112; Bull. 38, pp. 111–112.

PETROLEUM

There has been no important development of petroleum in San Luis Obispo County for many years, although there is considerable leasing activity in the vicinity of the old Arroyo Grande oil field at the present time. It is said that this activity is due to the prospect of finding a new and deeper oil horizon.

The *Arroyo Grande oil field* is located along Pismo Creek, about four miles northwest of the town of Arroyo Grande. Most of the wells are on the north flank of a syncline. The oil originated in the Monterey shale and has collected in the overlying sands of the Pismo formation (Santa Margarita formation, upper Miocene). Dollie Adams holds the principal interests in this field. From 12 to 14 wells are reported to be producing on an average of about nine barrels each per day of 14° Baumé gravity oil. Two wells are being drilled in the field. The field's production for the past three years was 66,281 barrels in 1932, 61,447 barrels in 1933, and 40,684 barrels in 1934. Practically the entire output was used for road surfacing.

The later development in the area has been in the southeastern end of the Arroyo Grande field, locally called the Oak Park field. The *Pismo Petroleum Corp.,* formerly *Elberta Oil Company,* has two wells here. Well No. 6 is pumping oil from a depth between 3195 and 3213 ft. The daily gross production is about 19 to 20 barrels, including water, or 7 to 8 barrels net oil. Their well No. 5 was shut off for water at the time of visit. The *J. D. Martin Oil Co.,* also located at Oak Park, is preparing to make production tests at two of their wells that have been successfully completed. They have completed building the tanks and sumps on their Pricco lease.

The following new wells have been reported ready to drill or drilling this year (September 28, 1935): Birch-Royer Oil Co., Sec. 33, T. 31 S., R. 13 E., B. E. Patchett, No. 1. Farrell Petroleum Co., Sec. 18, T. 31 S., R. 12 E. Taft Well Drilling Co., Sec. 31, T. 31 S., R. 13 E.

A new area in the Arroyo Grande field will be proved if the Birch-Royer well is a producer.

Unsuccessful drilling operations have been carried on in different portions of the county in the past, notably in the Huasna District, Cuyama Valley, Carrizo Plains, Cholame, Templeton-Atascadero area, and near Morro Bay.

The geology and oil possibilities of the county are described in the publications listed in the bibliography, and oil field development operations are reported in current numbers of 'Summary of Operations, California Oil Fields,' issued by the State Division of Oil and Gas.

Bibl: State Mineralogist's Reports VII, pp. 97–99; VIII, p. 530; XII, p. 356; XV, pp. 697–698; XXI, p. 528; State Mining Bureau Bull. 19, p. 146; Bull. 69 (and Map Folio) p. 418, pp. 429–434; Bull. 89, pp. 94–101. U. S. Geol. Survey San Luis Folio 101. XXII Annual Report, Pt. 1; Bull. 406; Bull. 621; Bull. 691.

PLATINUM

Platinum and gold occur in some of the beach sands, but the values are so low that their operation has not been profitable. However, early reports do state that the beach sands in the southern portion of the county were economically worked for their gold content.

Traces of platinum in peridotite from the Santa Lucia Mountains near Santa Margarita are reported to have been found in analyses made by Baker and Company, according to State Mining Bureau Bulletin 85.

Bibl: State Mineralogist's Report XXI, p. 528; State Mining Bur. Bull. 85, p. 95; Bull. 91, p. 24.

QUICKSILVER

There are five quicksilver districts in San Luis Obispo County, four of which are adjacent. These four, the Oceanic, Adelaida, Pine Mountain, and San Carpojaro districts are somewhat closely grouped together in the northwestern part of the county, being located in zones along the ridges and spurs of the Santa Lucia Range, and separated by more or less barren sections of country. The Rinconada and Deer Trail mines, situated away from the main quicksilver producing area mentioned, are southeast of Santa Margarita, and may be designated as a separate district.

The character of the ore of the latter mines may be classified as sedimentary formations impregnated with cinnabar and carrying high percentages of pyrite, like the Oceanic, and ores which are highly silicified metamorphics (including serpentine). The mines in the northwestern portion of the county lie mainly in the Franciscan and Cretaceous rocks. Bulletin 27, "Quicksilver Resources of California," by Wm. Fortsner (1903), and Bulletin 78, "Quicksilver Resources of California," by Walter W. Bradley (1918), contain geological maps of the principal quicksilver districts. More detailed descriptions of some of the properties mentioned herein are given in those two bulletins.

Quicksilver operations were quite active in the county at the time of visit in July, 1935. The Oceanic and Klau Mines, the two largest mines in the county, and a number of smaller properties, were in operation. The present price of quicksilver, $67.00 to $72.00 per 76-pound flask, although not high, permits a profitable operation of properties in San Luis Obispo County that were closed down following the post-war period of extremely low prices for the metal.

Cambria Mine (formerly the *Bank Mine*). This property, situated in Sec. 36, T. 26 S., R. 8 E., M. D. M., 13 miles northeast of Cambria by road, is owned by Hamilton Carhartt, Jr., 535 S. Catalina Ave., Pasadena. The mine has not been active since August, 1916, although leasers have worked part of the old furnace dumps, the brick furnace, and condensers since then. E. R. Lewis and partner worked these old bricks and tailings during the fall of 1934. Another party also did a little work here the past winter. Recent operators have apparently used the four-pipe retort that is on the property. This property produced considerable quicksilver between 1905 and 1908, but was closed down in 1916 because development work failed to locate an orebody. Carhartt states that two new cinnabar outcrops have been noted, and that native mercury has been found in and surrounding the creek to the north and west of the old furnace, but that no developments have been made on same. Idle, when visited.

Bibl: State Mineralogist's Report XV, pp. 700–705; XXI, p. 530.
State Mining Bur. Bull. 27, p. 154; Bull. 78, pp. 128–131.

Cypress Mountain Group. This patented property, consisting of 160 acres, is in Secs. 1 and 2, T. 27 S., R. 9 E. Kenneth Kingsbury, Standard Oil Bldg., San Francisco, reported to be owner.

Deer Trail Mine. M. H. Stevens, 835 High Street, San Luis Obispo, John W. Adams, Wm. Arebalo, owners. This group, consisting of two claims and millsite, is located in Sec. 32, T. 32 S., R. 16 E., about 7 miles east of Huasna or 20 miles from Arroyo Grande. The Deer Trail mine, like the Rinconada mine, is entirely apart from the main quicksilver producing area of San Luis Obispo County, which is located in the northwestern corner.

A. N. McCarthy secured a three-year lease on the property in March, 1931. However, a new lease was drawn up shortly thereafter to A. N. McCarthy, John C. Freeman, and J. Beatham, who carried on business under the name of *Alamo Mercury Co.* John C. Freeman took entire charge later on and did about 1000 feet of development work, producing 106 flasks of quicksilver in 1931 and 1932. Twelve men were employed at that time. McCarthy tore down the 12-pipe retort, which was built in 1916. The Alamo Mercury Co. later built a six-pipe 'Rossi' retort at the foot of the hill. This was torn down after a brief operation and a 'Wyatt' retort built up near the portal of the main tunnel.

The 'Wyatt' retort consists of three 20-inch pipes on about a 38° incline. Ore was charged into hoppers at the upper ends of the retort pipes about every 30 minutes, depending on the type of ore. A baffle is situated a few feet down from the hopper of each pipe, above the exit pipe, sealing the upper end of the pipe with ore so that furnace gases do not escape. The retort pipes run through the firebox, allowing the burned ore to be discharged into cars, direct from the furnace. Black diesel oil, atomized, was used to fire the furnace. The oil was fed by gravity from a 100-barrel corrugated-iron tank situated on the hill above the reduction plant. The firebox temperature was kept at 1350° F. The furnace gases were carried to a series of five 10-ft. by 2-ft. hollow-steel tanks for condensation. This furnace is not now in use, but it is said that it was capable of treating six to eight tons per 24-hour day. The furnace consumed about 2 barrels of diesel oil a day.

Robert Vehus, with two other men, has been working the mine on a small scale since January, 1935. He is using a 2-pipe 'Rossi' retort to recover the quicksilver, treating about one-half ton of ore daily. The retort is situated at the bottom of the hill, necessitating trucking the ore down from the mine by automobile.

The claims cover a series of narrow calcite veins striking east across a low ridge trending north-south. The country rock is a metamorphic sandstone. The cinnabar occurs in knife-blade seams and vugs in the more-or-less brecciated calcite veins. The upper tunnel, 80 ft. in length, is connected by winze to the second tunnel, 50 ft. lower, on the principal vein. When visited, a 35-ft. winze was being sunk in an orebody from the second tunnel, about 150 ft. in from the portal of the tunnel. A 120-ft. winze, with windlass, connects this level to the lower main or third tunnel. The main tunnel (called "fourth tunnel" in State Mineralogist's Rept. XXI) is about 450 ft. long, and has about 350 ft. of cross-cutting. Some development has been carried on a 40-ft. tunnel, about 80 ft. west of the upper tunnel, drifting in on a calcite lead, and on another 50-ft. tunnel situated on the west side of the hill. Most of the present work is confined to the second tunnel. This level has about 75 ft. of crosscutting.

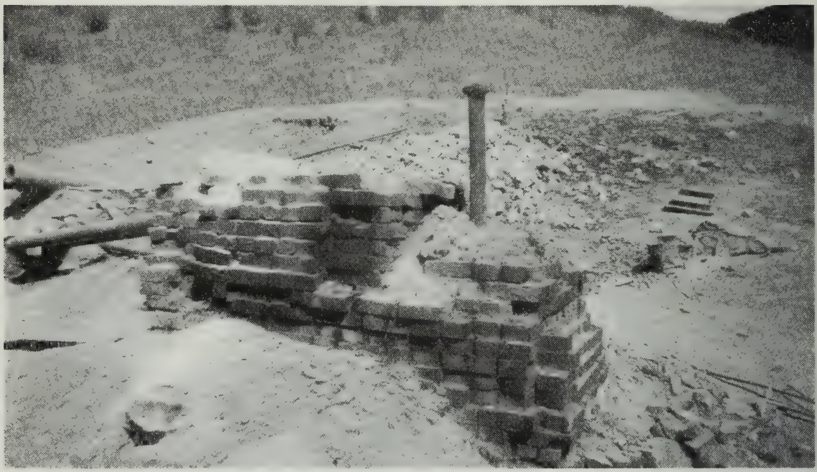


FIG. 3. Rossi-type quicksilver retort, 2 pipes, at Deer Trail Mine, San Luis Obispo County.

Bibl: State Mineralogist's Report XXI, pp. 530–531; State Mining Bur. Bull. 78, p. 133.

Fitzhugh Ranch Deposit (formerly *Benton Ranch, Lehman Mine*). This property is located in Sec. 13, T. 27 S., R. 9 E., 12 miles east of Cambria. Bucklin and Witcher took a lease on the mine in 1933, working it intermittently for five months. They cleaned out and extended several short tunnels, producing a little quicksilver. They did not clean out the 800 ft. tunnel on the property. Wm. Fitzhugh and son, Cambria, owners. Now idle.

Jacks or La Libertad Mine. (*Belt*) This mine is situated in Sec. 21, T. 27 S., R. 10 E., and is owned by C. C. Thompson, 7 X Ranch, Adelaida, California.

Ernest E. Lynch moved his reduction equipment from the Mahoney Mine (described on page 442) to this property shortly after the writer's visit in July, 1935. The two banks of 2-pipe Rossi retorts located on the property are not now used. Three of the old tunnels on the property are caved in. Mr. Lynch is working a comparatively new tunnel, 300 ft. long, with a 75-ft. crosscut. A 27-ft. winze has been sunk at the end of this crosscut, where much ore had been stoped out. Ten pound ore is being treated.

> Bibl: State Mineralogist's Report XV, p. 700; XXI, p. 532; State Mining Bur. Bull. 27, p. 159; Bull. 78, p. 138.

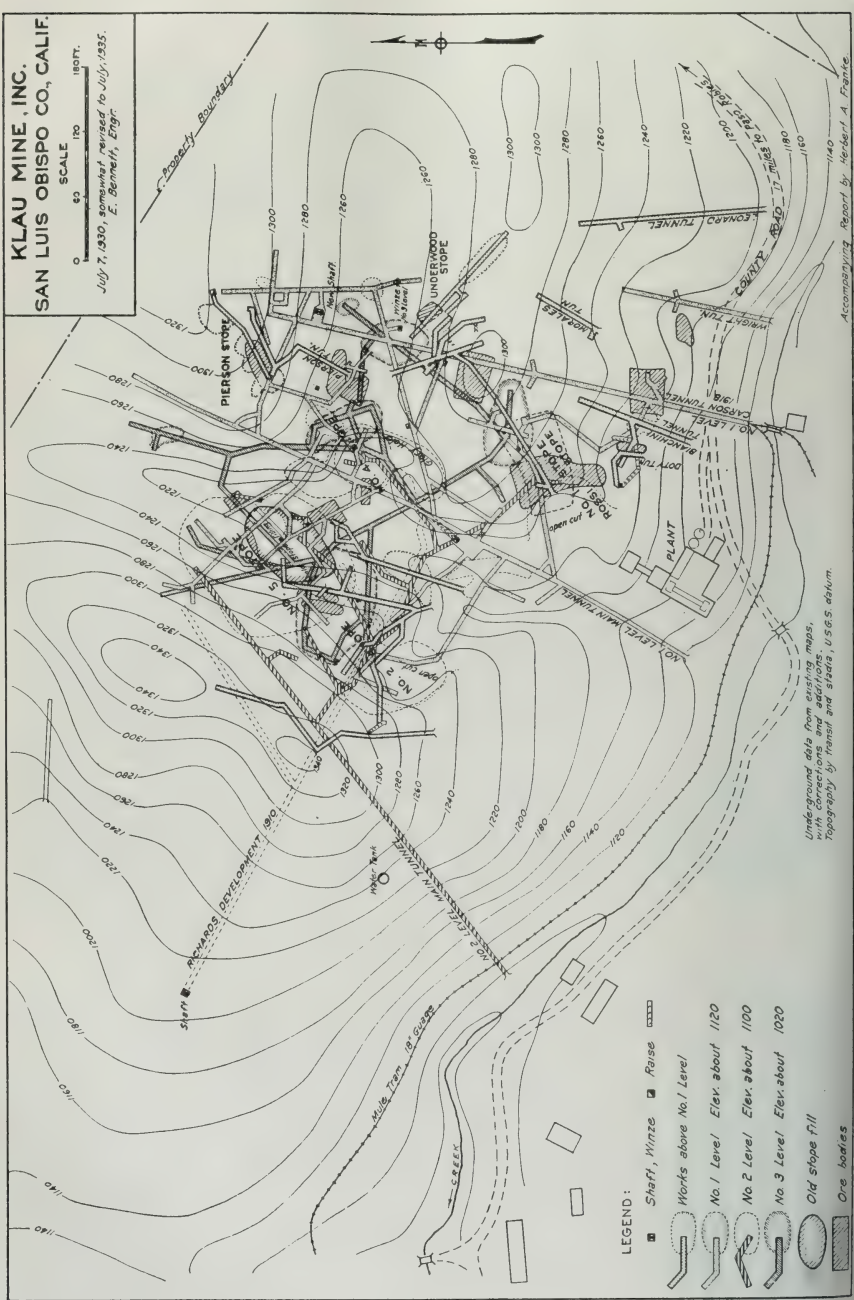
Josephine Group (also *Tartaglia* or *George Mine*). These two claims are situated in Sec. 29, T. 27 S., R. 10 E., 20 miles west of Paso Robles. Mineral rights are reported to be owned by Joe Tartaglia, San Luis Obispo. Idle.

> Bibl: State Mineralogist's Report XV, p. 720; XXI, p. 531; State Mining Bur. Bull. 27, p. 157; Bull. 78, p. 134.

Keystone Mine. This mine is on patented land in Sec. 13, T. 26 S., R. 8 E., and is owned by Phelan Brothers, Cambria. The proprety has been credited with considerable production during the seventies, but has not been active in recent years.

> Bibl: State Mineralogist's Reports X, p. 581; XV, pp. 113–114; XXI, p. 531; State Mining Bur. Bull. 78, pp. 134–135; U. S. Min. Resources West of the Rocky Mtns. 1875, p. 14.

Klau Mine (also sometimes known as *Sunderland, Santa Cruz, Karl, Sierra Morena* or *Carson Mine.*) Includes *Capitola* and *Santa Monica Claims.* Ellard W. Carson, 714 Buchon Street, San Luis Obispo, owner. It is now being operated under lease by H. W. Gould and Richard A. Hanan as Klau Mine, Inc., address 10 Penthouse, Mills Building, San Francisco. The group includes 187 acres of patented land and four unpatented claims, being in Sec. 33, T. 26 S., R. 10 E., M. D. M., Adelaida District, at an elevation of 1400 ft., on the eastern side of the Sierra Santa Lucia, 17 miles west of Paso Robles. It is one of the largest and most developed quicksilver properties in the county. The original location was made in 1868 and it has been an intermittent producer ever since. The Klau was the fourth largest producer in the state in 1902, producing approximately 3300 flasks. The furnace plant burned in 1911 and the property was idle until 1915, when it was leased and some production made by retorting high-


KLAU MINE, INC.
SAN LUIS OBISPO CO., CALIF.
SCALE
0
60
120
180FT.
July 7, 1930, somewhat revised to July, 1935.
E. Bennett, Engr.
Property Boundary
PIERSON STOPE
UNDERWOOD STOPE
New Shaft
Winze No.3 Level
PIERSON TUN.
LEONARD TUNNEL
MORALES TUN.
WRIGHT TUN.
COUNTY ROAD 17 miles to Paso Robles
CARSON TUNNEL 1918
NO. 1 LEVEL
BIANCHINI TUNNEL
DOTY TUN.
ROSSI STOPE
NO. 4 STOPE
NO. 5 STOPE
NO. 2
open cut
PLANT
NO. 1 LEVEL MAIN TUNNEL
NO. 2 LEVEL MAIN TUNNEL
RICHARDS DEVELOPMENT 1910
Shaft
Water Tank
Mule Tram 18" Guage
CREEK
1120
1140
1160
1180
1200
1220
1240
1260
1280
1300
1320
1340
LEGEND:
Shaft, Winze
Raise
Works above No. 1 Level
No. 1 Level Elev. about 1120
No. 2 Level Elev. about 1100
No. 3 Level Elev. about 1020
Old stope fill
Ore bodies
Underground data from existing maps, with corrections and additions. Topography by transit and stadia, U.S.G.S. datum.
Accompanying Report by Herbert A. Franke.

grade ore. (See Bulletin 78 for a more complete history prior to 1918.)

E. W. Carson purchased the property in 1918, rebuilding the old 50-ton Scott furnace and otherwise rehabilitating the plant and mine. The plant had just started when the post-war slump of the quicksilver market forced it to shut down. Since then leasers have worked small high-grade pockets along the outcrop and reclaimed ore from around the old open cuts. All of this ore was treated in pipe retorts.

The total production to the end of 1935 was 15,580 flasks of quicksilver, all of which has come from a depth of 200 ft. or less from the surface. During the past three years there were approximately seventeen leasers, producing from 15 to 20 flasks per month. Most of the high-grade ore that they extracted was treated in a 4-pipe Rossi retort. Louis I. Rossi was one of these leasers. The Klau Mine, Inc., took over the property in August, 1934, commencing to operate their new reduction plant in January, 1935. This new plant is situated about 700 ft. southeast of the old Scott furnace, now partly torn down.

According to the engineers' reports there are three nearly parallel ore-bearing zones. Very little work has been done on the third, or most northerly zone. The ore has been followed down from the outcroppings a vertical distance of approximatelly 200 ft. on the other two zones. These orebodies occur in a broad fault or crushed zone having a NW. trend, dipping NE. The cinnabar is found in the fractured sandstone and shale between heavy fault gouges, often called serpentine, and also to some extent disseminated in the less-disturbed sandstone under some of the gouges. One report states that the ore-bearing area has a width of 400 to 500 ft. for a mile in length. The main orebodies that have been worked are confined to an area about 500 to 600 ft. in the center of the property.

The present operators have not discovered any new mineralized zones. Present work is above the old lower workings, in the Underwood, Rossi, and Pierson stopes, and development work around the edges of No. 4 and No. 5 Stope. Green and white mud-gouge seams are being encountered in the development work on the southwesterly ore zone, especially in Stopes No. 2 and 5. This is said to be a good sign because the ore is present in the gouge or more often in its accompanying rock. Some of the ledge matter of this orebody is loose, coarsely-granular quartz, carrying iron and mercury sulphides. In this loose quartz are found boulders of very hard chalcedonic quartz and of a laminated somewhat-calcareous material. Some ore is being taken from this chalcedonic and calcareous material, but more ore is taken from the sandstone. A 135-ft. incline shaft, at an angle of 16° and 24°, was recently sunk, going through one old stope, to 15 ft. above the main No. 1 level. A new orebody off of No. 5 Stope was tapped while cleaning silt of an old level and crosscutting to No. 5 from the new incline. The present company plans to deepen the new incline, 15 ft. to the old main No. 1 level and work the property from it. Ore had been mined by open-stope methods, with an occasional stull used to hold loose ground. Present operations have encountered wet ground, necessitating square setting. Ore of 6 to 10 pounds content is being treated.

The mined ore is delivered to the bottom of the incline by gravity. The ore cars, of $\frac{3}{4}$-ton capacity, are hauled up the incline by gasoline engine hoist. The ore from the portal of the incline shaft is trammed 150 ft. south to a 40-ton capacity mill and crushed to 2-inch size. A 40-ft. conveyor belt takes the crushed ore to a 50-ton fine-ore bin, from where the ore is fed by shaker feeder to 3-ft. x 40-ft. Gould rotary furnace. Fuel consumption is 6½ gallons of diesel oil per ton of ore treated. The oil (24° to 28° B.) costs 4.9 cents per gallon; and 40 tons of ore are being treated daily. A 9-inch suction fan pulls the furnace gases through a Sirocco cyclone. The kiln gases continue to one unit of sixteen 16-inch double-decked cast-iron vertical-pipe condensers. Rubber buckets catch the soot and quicksilver from the eight hoppers. The soot and quicksilver are hoed with lime. The

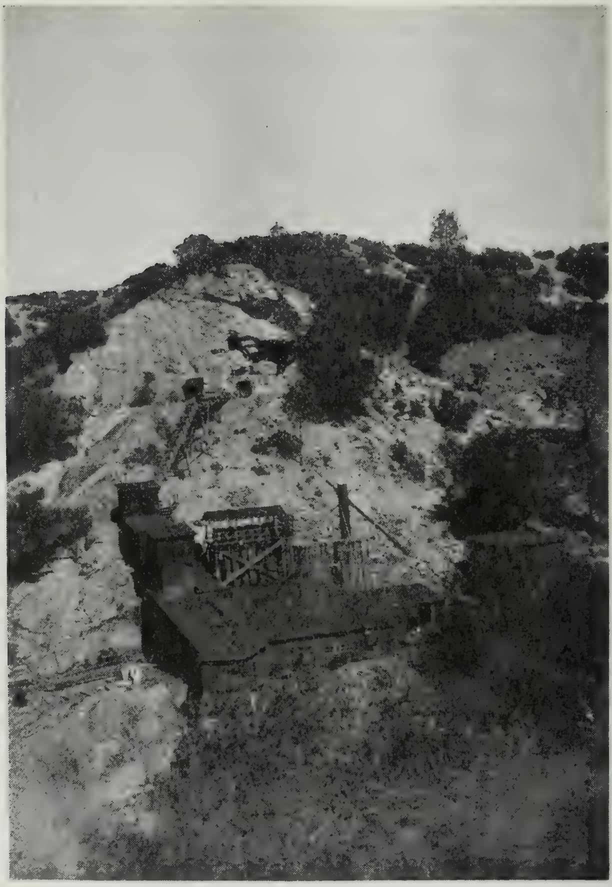


FIG. 4. Glory hole, now site of new incline shaft, and reduction plant at Klau Quicksilver Mine, San Luis Obispo County.

remaining material, after the quicksilver has been drawn off, is fed through the rotary furnace. The gases continue from the pipe condensers to two hollow 10-ft. by 20-ft. redwood tanks, with Pachuca bottoms, and then pass out of a 20-ft. wooden stack on the second or last tank. Extraction of quicksilver is said to be better than 95%; and 50 to 60 flasks are produced monthly.

A General Electric generator connected to a 40-h.p. stationary Fairbanks-Morse diesel engine supplies the plant and buildings with power and light. A portable Ingersoll-Rand compressor, 230-cu. ft. capacity, supplies the mine with compressed air. The mine has natural ventilation. A total of 20 men are employed, including 13 underground, 4 top men, and 3 mill men. The labor is mostly Mexican and Spanish. The mine staff includes: Bruce A. Gould, superintendent; Joe Y. Rodriguez, mine foreman; and R. J. Bell, mill foreman.

Bibl: State Mineralogist's Reports IV, p. 336; X, p. 580; XII, p. 366; XIII, p. 600; XV, pp. 709–711; XXI, pp. 531–532; State Mining Bur. Bull. 27, p. 157; Bull. 78, pp. 135–138. U. S. Geol. Survey Mon. XIII, pp. 382; Min. Res. West of the Rocky Mtns., 1875, p. 14; 1876, p. 20. Mining and Scientific Press, Nov. 12, 1904.

Little Bonanza Group (including *Alice, Alice No. 2, Ida, Echo,* portion of *Modoc,* some of which were formerly *Elizabeth* and *Winona Group*). The Little Bozanza (*Josephine*) consists of one patented claim in Sec. 17, T. 27 S., R. 10 E., M. D. M., in the Adelaida District. Earl Merrifield, Adelaida, and Ruby Davis Estate, c/o F. H. Benson, Attorney, San Jose, own the Little Bonanza. Development work on this claim consists of the main tunnel level, 1500 ft. long, mostly accessible; two 175-ft. tunnels; and a 200-ft. tunnel up the hill. The old rotary furnace has been abandoned and two separate four-pipe 'Rossi' retorts have been used most recently. One of these 'Rossi' retorts is situated near the old rotary furnace and the other up the hill near the 200-ft. tunnel. These retorts had not been operated for several months at the time of visit (July, 1935). The property has been worked by several different parties in the past few years. Earl Merrifield operated the property last in 1934. A fair production from the property was realized in 1934. The ore is in the form of a network of cinnabar veinlets, and cinnabar on fracture faces, in a silicified, altered serpentine.

Three other claims, the Alice No. 2, Ida, and Echo, filed on under the name of N. S. Lewin, San Luis Obispo, are located near the Little Bonanza. The Alice No. 2 claim is said to have been worked as far back as 1862. It is reported to have five tunnels, 400 ft., 170 ft., 75 ft., 60 ft. and 50 ft. long, as well as a 25-ft. shaft. Some of this development has been done recently. The Ida and Echo claims are developed by open cuts.

About six acres of the Modoc claim is owned by Mrs. E. Bagby, 1520 Park St., Paso Robles.

Bibl: State Mineralogist's Reports X, p. 580; XV, p. 711; XXI, pp. 532–533; State Mining Bur. Bull. 27, p. 154; Bull. 78, pp. 138–139. Min. Res. W. of Rocky Mtns. 1875, p. 14.

Lucky Boy, Wall Street, Big Bug, and *Ohio Claims* have been located in Rim Rock Canyon, not far from Rinconada Mine, by J. W. Smith and A. C. Epperly of Santa Margarita. Assessments only.

Madrone Mine. This property in Sec. 22, T. 27 S., R. 10 E., adjoining the Jack's Mine, is owned by Harry Marquat, Cayucos, California. It was a producer about 1900, but the workings are all superficial. Idle.

Bibl: State Mineralogist's Report XV, p. 712; XXI, p. 533; State Mining Bur. Bull., p. 161; Bull. 78, pp. 139–140.

Mahoney Mine (also called *Gould* or *Buena Vista*). This patented property is situated in Sec. 33, T. 26 S., R. 10 E., south-east of the Klau Mine. Miss Mary I. O'Toole, 338 Church St., Gilroy, owner. Ernest E. Lynch, 2309 Encinal Ave., Alameda, was operating the property, with the owner's permission, at the time of visit.

Tunnels No. 1, 2, and 3, stated to be in 370 ft., 150 ft., and 225 ft., respectively, are not being worked because of their caved condition. Tunnels No. 1 and 2 are badly caved, but No. 3 tunnel is only partially caved and is accessible. A 45-ft. shaft was sunk on top of the hill in 1932. Ore for present operations is coming from three open cuts on the hillside, being hauled to the temporary plant by a Ford truck.

The ore is reduced to $\frac{1}{4}$-inch fineness by a crusher of Mr. Lynch's own design. It is then screened, oversize material going to a dump for later milling. The finely screened material goes to a 'Lynch' concentrating table (resembling a Wilfley table). The cinnabar concentrates are sun dried and retored in a 'Lynch' pot retort. The pot retort has a flat-slanting cover. A water-jacketed condensing pipe is attached to the upper side of the pot. The pot will hold 150 pounds of cinnabar concentrates, recovering 10 to 25 pounds of clean quicksilver with each 12-hour charge. A low-grade fuel oil, under pressure, with blow-torch type burner, is used to fire retort. Five gallons of fuel oil are used per 24-hour day. A 2-k.w. Emerson generator, 220V., run by a Star gasoline engine, supplies power to run the screener and concentrator. Five men are employed. The present operator has been working the property since April, 1935, recovering about a flask of quicksilver per week. (Since the above was written Mr. Lynch has ceased operations. A bond and lease has been given on the property and operations are hoped to commence shortly.)

Bibl: State Mineralogist's Report XV, p. 712; XXI, p. 533; State Mining Bur. Bull. 27, p. 161; Bull. 78, p. 140.

Mercury Mine. This property consists of three claims, totaling 55 acres, located in the SW$\frac{1}{4}$ of the NW$\frac{1}{4}$ of Sec. 7, T. 27 S., R. 10 E., on the eastern slope of Cypress Mountain, at an elevation of 2330 ft. It is said that this property was first located in 1874. M. D. Gaines, Morro Bay, R. S. Gaines, and Wm. McKeon, the present owners, relocated the claims on June 14, 1931. Present development work consists of a 70-ft tunnel and numerous open cuts. The country rock is serpentine and altered sandstone.

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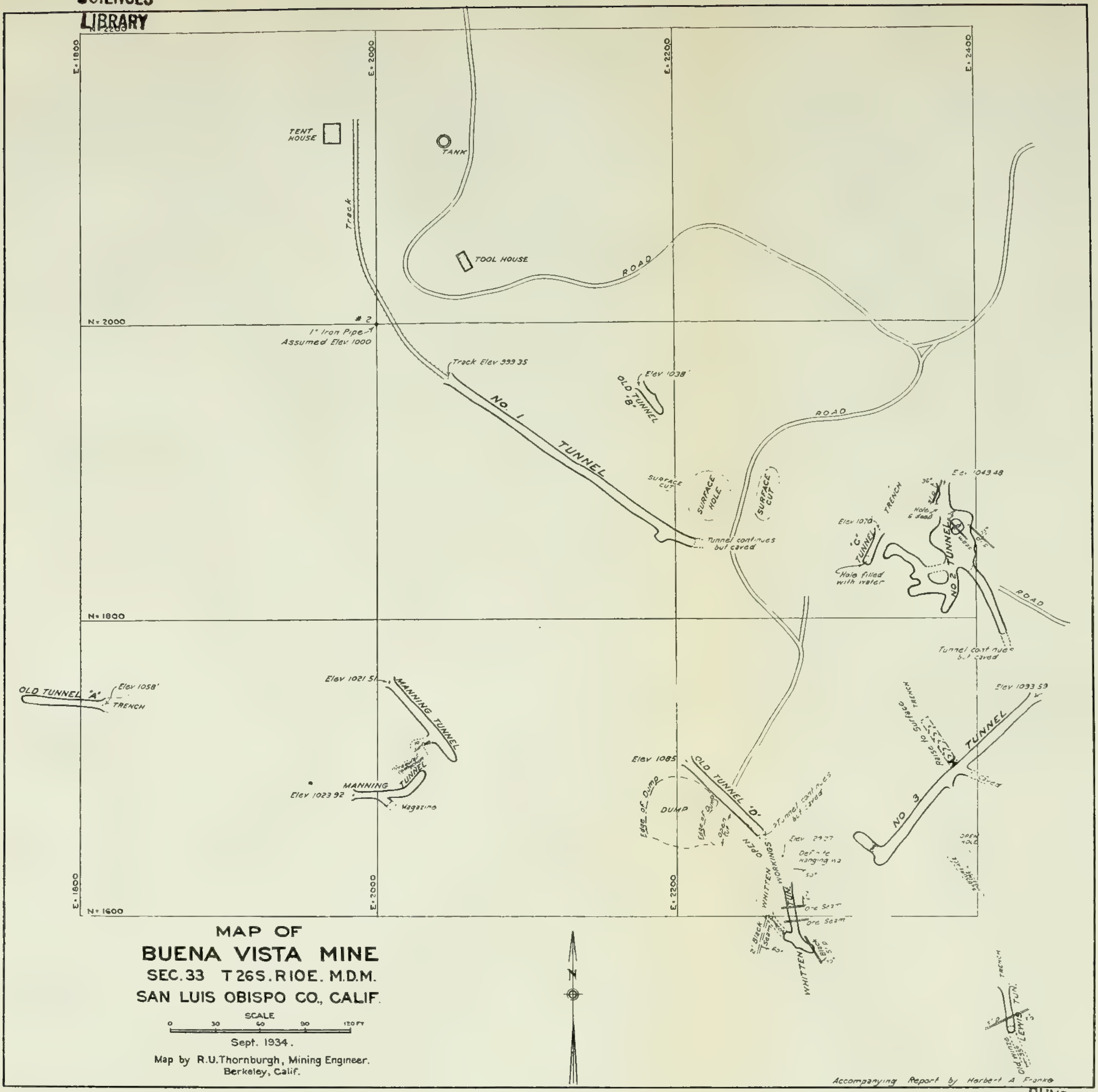
N. 2200
E. 1800
E. 2000
E. 2200
E. 2400
TENT HOUSE
TANK
Track
TOOL HOUSE
ROAD
N. 2000
# 2
1" Iron Pipe
Assumed Elev 1000
Track Elev 999.35
No. 1 TUNNEL
Elev 1038'
OLD TUNNEL 'B'
ROAD
SURFACE CUT
SURFACE HOLE
SURFACE CUT
Tunnel continues but caved
Elev 1043.48
TRENCH
36°
Hole 6 deep
Elev 1070
'C' TUNNEL
Hole filled with water
NO 2 TUNNEL
ROAD
N. 1800
Tunnel continues but caved
OLD TUNNEL 'A'
Elev 1058'
TRENCH
Elev 1021.51
MANNING TUNNEL
MANNING TUNNEL
Elev 1023.92
Magazine
Elev 1093.59
TRENCH
Raise to Surface
NO 3 TUNNEL
Caved
Elev 1085
OLD TUNNEL 'D'
Edge of Dump
DUMP
Edge of Dump
Open Cut
Tunnel continues but caved
OPEN
WHITTEN WORKINGS
Elev
Definite Hanging wall
50°
OPEN HOLE
TUN.
Ore Seam
Ore Seam
2' Black Seam
Black
WHITTEN
N. 1600
N
TRENCH
LEWIS TUN.
Old Winze

MAP OF
BUENA VISTA MINE
SEC. 33 T 26 S. R 10 E. M.D.M.
SAN LUIS OBISPO CO., CALIF.

SCALE
0 30 60 90 120 FT

Sept. 1934.

Map by R.U. Thornburgh, Mining Engineer.
Berkeley, Calif.

Accompanying Report by Herbert A Franke

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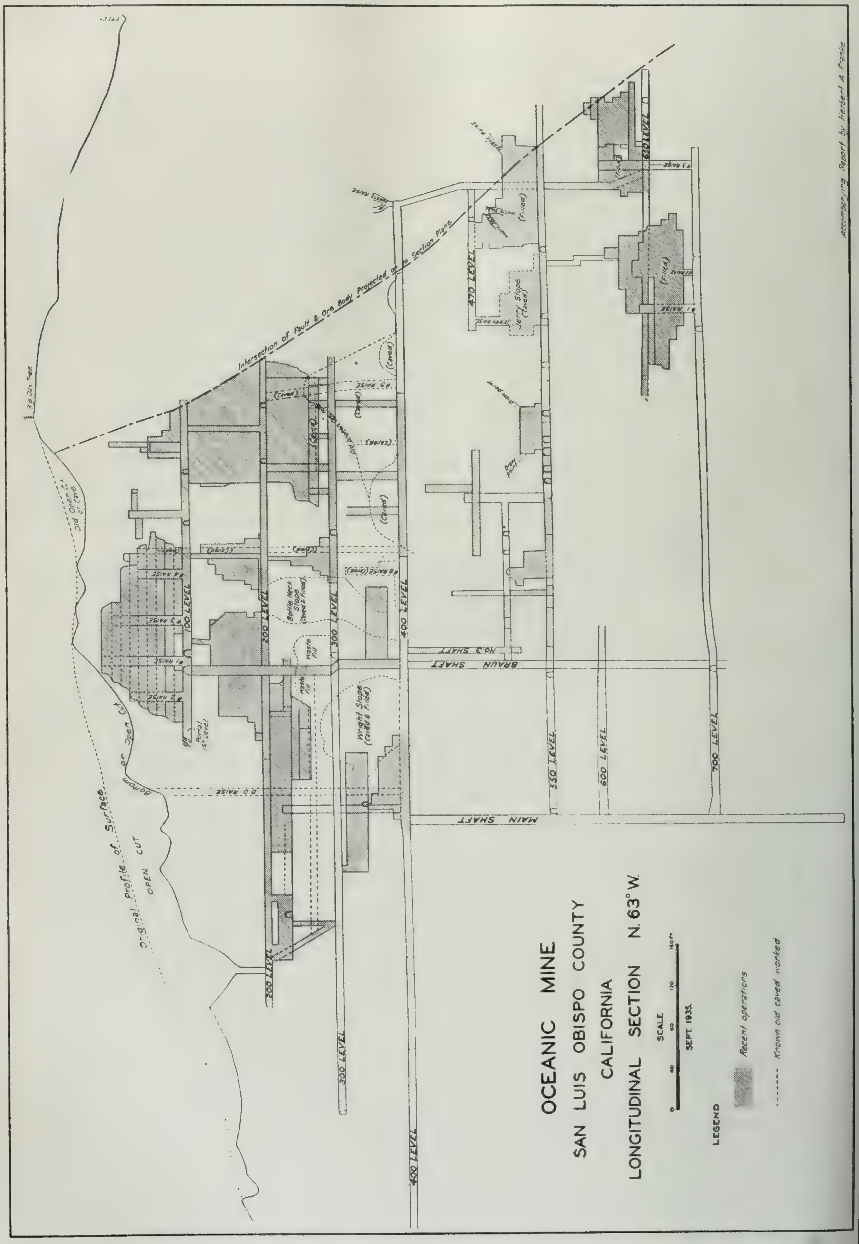
Mercury Nos. 1, 2 and 3. These two and a fraction claims, 55 acres, were filed on in 1934 by A. B. Jesse, c/o Sears, Roebuck & Co., San Luis Obispo. These claims adjoin the Little Bonanza. One man is working on the property at the present time. There are three open cuts and a 150-ft. tunnel which carry cinnabar ore, and another 250-ft. tunnel which has not yet reached ore.

Oceanic Mine. Anglo-American Mining Corporation, Ltd. (formerly Consolidated Metals Corporation), 1005 Mills Building, San Francisco, owner; W. Lyman Brown, president; H. W. Klipstein, vice president. The technical staff includes: A. W. Frolli, manager; M. J. O'Boyle, superintendent; H. E. Ingersoll, plant foreman; and Chas. Persinger, mine foreman. It includes 400 acres of mineral rights and 3 patented claims in Secs. 15 and 21, T. 27 S., R. 9 E., five miles easterly from Cambria on Santa Rosa Creek. President Lincoln signed the patent for the three original claims granted in 1865. Production began in 1876. The mine has been closed down at various intervals since, due to depressions in the quicksilver mining industry; but it ranks as the largest quicksilver producer in San Luis Obispo County and one of the important mines of the state. It has been extensively developed and well equipped with mining and reduction works. The reader is referred to Bulletin 78, published in 1918, for a detailed early history and description of the Oceanic, including a map of the old mine workings.

A brief history of the property subsequent to the time mentioned in Bulletin 78, as obtained from reliable parties, is given herein. Murray Innes, owner of the Oceanic, regained control of the property early in 1917 when Edward A. Clark et al. of New York gave up their bond. He is said to have operated the property from 1916 until 1920, when the mine was shut down on account of the low price of quicksilver. The mine was mortgaged to the Roywood Finance Co. in 1922, and in 1925 this company commenced to operate the property. The 'main shaft' was deepened to the 800 level and some development work done, but the reduction plant was not operated. Gas was encountered while drifting to the footwall on the 800 level, causing two explosions and killing two men. H. W. Gould obtained the property in the fall of 1926 and leased it to the International Mercury Co. of Los Angeles. The mine was reopened to the 700 level in 1927, and in 1928 a 4-ft. by 60-ft. Gould rotary furnace and tile condenser system was installed, abandoning the Scott furnaces. H. W. Gould took over the actual operation of the property in the fall of 1928 and continued to work it until the Consolidated Metals Corporation purchased the property on April 1, 1930. Considerable additional equipment was installed and improvements made at the mine and reduction plant by this concern. Their development program, which has continued to date, consisted of opening up more ore between the surface and the 700 level in the southeast portion of the mine, and recovering blocks of ore in various parts of the mine that were abandoned by previous operators but which could be mined at a profit. The results of this development work have exceeded expectations. The property was closed down in July, 1932, due to the low price of quicksilver. The assets of this company were taken over by the Anglo-American Mining Corporation, Ltd., in April


OCEANIC MINE
SAN LUIS OBISPO COUNTY
CALIFORNIA
LONGITUDINAL SECTION N. 63° W.
SCALE
0
40
80
120
160 Ft.
SEPT. 1935
LEGEND
Recent operations
Known old caved worked
Accompanying Report by Herbert A. Franke
Original Profile of Surface
Bottom of Open Cut
OPEN CUT
Old Open Cut or Cave
Intersection of Fault & Ore Body Projected on to Section Plane
100 LEVEL
200 LEVEL
300 LEVEL
400 LEVEL
470 LEVEL
550 LEVEL
600 LEVEL
650 LEVEL
700 LEVEL
MAIN SHAFT
BRAUN SHAFT
NO. 3 SHAFT
Bottle Neck Stope (Caved & Filled)
Wright Stope (Caved & Filled)
Jerry Stope (Caved)
Waste Fill
(Caved)
(Filled)
Draw Point
Portal 1st Level
No. 1 RAISE
No. 2 RAISE
No. 3 RAISE
No. 4 RAISE
No. 6 RAISE
No. 8 RAISE
No. 9 RAISE
No. 10 RAISE

1933. The mine was reopened in June, 1934, and production has continued since then.

The ore is a dark-gray, fine-grained sandstone, containing enough calcite to cause marked slaking on exposure. It also contains some petroleum and considerable pyrite. The ore strikes NW.-SE., and the dip is nearly vertical, though in places it reverses itself, being mainly NE. It has a serpentine hanging-wall and shale footwall. The following excerpts are taken from A. W. Frolli's report on the geology and ore deposits:

> "The geology of the Oceanic district is complicated, and the rocks belong almost entirely to the Franciscan series, except for remnants of Miocene strata which overlie or are faulted against it.
>
> "At the Oceanic mine the ore, which is principally cinnabar, occurs as 'nuggets,' which are a replacement of fossils, and as finely disseminated particles throughout favorable sandstone formations. The main orebody outcrops along the crest of a high hill and can be traced for over 500 feet distant. The ore shoot, which has about the same attitude as the sandstone formations, has a N. 65° W. strike, a nearly vertical dip, and rakes to the southeast. It has a length of 550 to 600 feet, a width of 15 to 40 feet, and the mineralization is almost uniform throughout, which is something unusual for a quicksilver mine. Generally speaking, the orebody can be considered as a disseminated deposit with no well-defined walls and in some cases shows a localization of values along indistinct fissures. The high-grade ore occurs in a coarse-grained gray sandstone and the lower grade ore in a fine-graded dark-gray sandstone. * * *
>
> "The ore shoot has been persistent from the outcrop to the lowest level developed (700 level) and both the high grade and lower grade sand ores have been encountered at this depth.
>
> "Old records and recent development work indicate that there is a parallel orebody just north of the main ore shoot. In the upper levels some mining was done on this orebody by the old timers and these records state that a crosscut on the 700 level cut 9 feet of good ore. * * *
>
> "A fault, which has about a N. 45° W. strike and 60°-70° dip to the N.E., cuts diagonally across the orebody and limits its southeast extension. Practically no development work has been done beyond this fault to pick up the faulted segment of the ore."

The mining methods in use are top-slice caving and square-set timbering with waste fill. In top slicing a 10-ft. section is taken at a time. Raises are driven about every 35 feet, for a stope about 100-ft. long. Two larger raises on each end are divided into an ore chute and man-way, while the middle raise is used only for ore. Most of the pine timber is obtained from the local forests. Large-size timber for square setting costs 6¢ to 7¢ per lineal foot, and lagging costs $6.50 to $7.00 per cord. The cost of hauling the timber to the mine is about 2½ cents per lineal foot, and the cost of hauling the lagging is about $2.00 per cord. Oregon pine is used for floors and sills.

No large new orebodies have been discovered to date by the present operators. Most of the development since 1918 has included the reworking of practically every previous level due to cavings. A winze was sunk below the 550 level in 1930, revealing ore averaging 8 lbs. per ton as far as the 650 level. Drifting on this level opened up approximately 300 feet of 6 to 7-lb. ore. A drift was driven off the main shaft on the 700 level later on and a considerable tonnage of 5 to 8-pound ore was blocked out between this and the 650 level.

The present operators, who commenced in 1934, have fully developed the 100, 200, and 300 levels, taking all available ore. The present 100 level did not previously exist, but when the present operators drove the tunnel they did encounter portions of the old so-called 150 level. An orebody overlooked or ignored by former operations was mined between the west end of the 100 level and surface. The new 200 level is through partly caved ground, but most of it is in new ground to the south of the old level. Most of the development work by the present company has been confined to the 300 level. Much of this work has been through barren country rock, enabling them to secure an outlet to the surface. Most of the mining by top slicing is confined to the east end of the orebody. At present (July, 1935) top slicing has been completed from 76.5 ft. above the 100 level to 40 ft. above the 300 level, over an area averaging about 20 ft. in width. Another top-slicing operation is on the 250 level. The square-set mining method is employed on the remainder of the present development, on the 100, 200, 200 sub-level, 300, 300 sub-level, 650, and 700 levels. Future plans are to continue top slicing in the zone, formerly called the Carson Stope area, between the 100 to 550 level. A new station may also be cut between the 400 and 550 levels for an outlet.

At the portal of the main 400 level are located the blacksmith shop, saw mill, compressor, crushers, and tramway loading terminal. Two Hercules-Blake jaw crushers break the ore to about 2-inch size. The ore is transported from the 60-ton capacity mine ore-bin to the furnace bins 2600 ft. by a Painter aerial tramway, having seventeen 10-cu. ft. buckets, and 75 tons of ore are delivered daily to the 1200-ton (750-ton cacapity in use) ore-bin at the furnace. The ore is not crushed again, but gravity fed into the rotary kiln by means of a 10-ft. chute to a kicker feeder.

Both of the former Scott furnaces have been almost completely torn down, and the brick treated for its quicksilver content. The new reduction equipment, installed in 1931, includes a 4-ft. by 60-ft. Gould-type rotary furnace, fired with diesel oil, atomized with 60 to 70 pounds air pressure. The kiln gases (negative draft) pass from the concrete dust chamber through a cyclone (manufactured by American Blower Corp.), which removes about 1000 pounds of dust daily, which is discarded. After the gases are distributed through the surge chamber, they are forced through a double-deck three-unit condenser system, consisting of cast-iron pipe, 18 inches outside diameter. Two 12-foot pipes are stacked upon each other, connected at the tops to the next 24-foot high pipe condenser by inverted U-bends. Each of the units contain seventeen 12-ft. pipes and 5 hoppers. The last vertical condenser pipe in each unit is equipped with inside sprinklers. The iron-pipe condensers are followed by four 10-ft. by 20-ft. redwood tanks in series. The first tank is equipped with baffles and sprinklers, the second tank with sprinklers only, while the last two tanks contain neither. Two rows of terra cotta pipe, each about 80 ft. long, lead away from the last tank to a 40-ft. redwood-pipe stack. From 10 to 18 flasks are recovered monthly from the stack, terra cotta pipes, redwood tanks, and the three iron pipes leading away from the three-pipe-condenser units.

The temperature of the rotary at the burner end is about 1300° F. The furnace gas temperature on leaving surge chamber is 400° F. The temperature of the gas leaving the iron condensers is 130° F., and stack temperature is about 90° to 110° F.

The quicksilver and soot taken from the condenser hoppers is placed on an inclined iron pan, 3 ft. by 6½ ft. by 6 inches deep, which is fitted with a gooseneck in the lowest corner. Lime, about one-third of the amount of quicksilver and soot, is added and mixed by hoeing back and forth over the pan. Sixty per cent of the total metal production is freed by this treatment. The remaining mixture is retorted in a 200-pound capacity cast-iron D retort, 8 ft. long, holding 4 pans. The charge is left in the D retort for 8 hours. This retort is fired with diesel oil. An 8-ft. pipe, with water running on outside, acts as condenser for this retort. This D retort recovers 40 per cent of the plant's total production, and is run continuously. The life of the retort is about nine to ten months with continuous use.

The mud and water from the condensers is run into four concrete settling tanks. This material is allowed to dry and then run through the rotary furnace. A Ford-driven locomotive, attached to the mine dump car, delivers the burned ore to the tailings pile. An average of 75 tons of 2-inch ore is treated daily. Fuel consumption for the rotary is 500 gallons of Dieselene (27° B.) daily, or 6.6 gallons of oil per ton of ore treated. The D retort consumes 50 gallons of oil daily. The cost of the fuel oil delivered to the mine is $3\frac{7}{8}$ cents per gallon.

Electric power, supplied by the Midland Counties Public Service Corporation, is used for lighting, heating, and to run the motors. Its cost is $1\frac{3}{4}$ cents per kilowatt hour. Other equipment, not heretofore mentioned, includes a 400-ft. electric hoist inside of 400 level, driven by 75-h.p. motor; several small air hoists; a 677-cu. ft. two-stage duplex Ingersoll-Rand compressor, driven by 100-h.p. motor; Gould Triplex pump and Dow Horizontal Duplex Piston pump on 700 level. An assay office is provided to handle mine and reduction plant samples. Water supply for the mine comes from two springs nearby. The mine ventilation equipment includes a $2\frac{1}{2}$-h.p. electric-driven Coppus blower, Connersville blower, and a number of Venturi-type injector blowers. The Venturi-type blower is used mainly, and it is fully described herein on page 448.

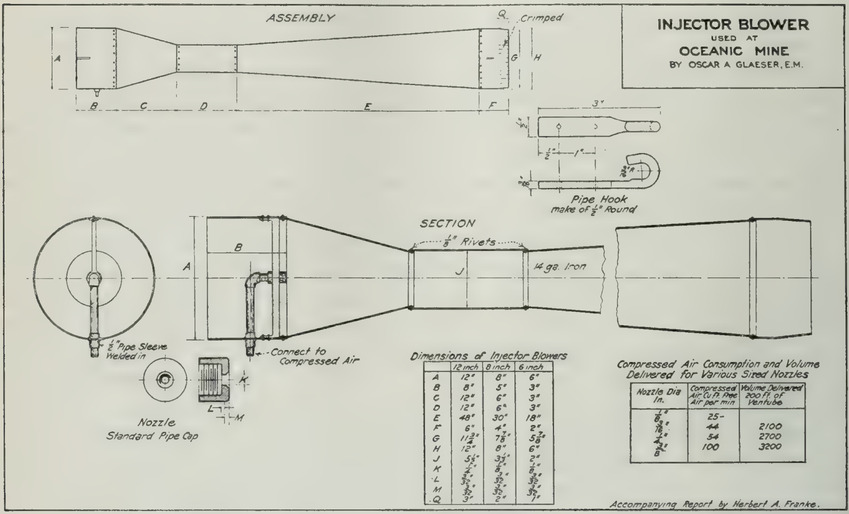
The total production of the mine to the end of 1935 was 35,482 flasks of quicksilver. Approximately 160 flasks of quicksilver are produced monthly, the ore averaging 5 to $6\frac{1}{2}$ pounds per ton. The recovery is claimed to be 90 to 95 per cent at the reduction plant.

A total of 44 men are employed, including 27 underground, 6 on top and 5 at the furnace. An extra night shift of six men underground was employed temporarily at the time of visit. The men are paid the following wages: machinemen and timbermen \$4.00; hoistmen \$4.00; trammers, muckers, and common laborers \$3.50. Board is charged at \$1.00 per day.

Bibl: State Mineralogist's Reports IV, p. 366; VIII, p. 531; X, p. 580; XII, p. 366; VIII, p. 600; XV, pp. 712–718; XXI, pp. 533–534; State Mining Bur. Bull. 27, pp. 151, 162, 243; Bull. 78, pp. 140–146; U. S. Bur. of Mines Bull. 335, pp. 85–86. U. S. Geol. Survey Mon XIII, p. 382; Min. Res. West of Rocky Mtns., 1875, p. 14; 1876, p. 20; A.I.M.E. Bull., Feb. 1915, pp. 497–504; Trans. Vol. LI, pp. 110-119, E. & M. J., Vol. 102, p. 512, 1916.

Venturi-Type Injector Blower. Oscar A. Glaeser, Safety Engineer, California State Compensation Insurance Fund, San Francisco, has kindly supplied the following description of the Injector Blower in use at the Oceanic Mine.

"The Injector Blower, or Venturi Blower as it is sometimes called because of the principle involved, is a sheet-metal tube consisting of an abrupt cone at the intake end, a short narrow throat, and a long cone with gently tapering sides at the discharge end. Necessary pipe connections and a nozzle made by drilling a pipe cap are attached at the intake end as shown in the drawing.


INJECTOR BLOWER
USED AT
OCEANIC MINE
BY OSCAR A GLAESER, E.M.
ASSEMBLY
Q
Crimped
A
B
C
D
E
F
G
H
3"
$\frac{1}{2}$"
1"
Pipe Hook
make of $\frac{1}{2}$" Round
SECTION
$\frac{1}{8}$" Rivets
J
14 ga. Iron
$\frac{1}{2}$" Pipe Sleeve
Welded in
Connect to
Compressed Air
K
L
M
Nozzle
Standard Pipe Cap

Dimensions of Injector Blowers

	12 inch	8 inch	6 inch
A	12"	8"	6"
B	8"	5"	3"
C	12"	6"	3"
D	12"	6"	3"
E	48"	30"	18"
F	6"	4"	2"
G	$11\frac{3}{4}$"	$7\frac{7}{8}$"	$5\frac{7}{8}$"
H	12"	8"	6"
J	$5\frac{1}{2}$"	$3\frac{1}{2}$"	2"
K	$\frac{1}{4}$"	$\frac{1}{8}$"	$\frac{1}{8}$"
L	$\frac{3}{32}$"	$\frac{3}{32}$"	$\frac{3}{32}$"
M	$\frac{3}{32}$"	$\frac{3}{32}$"	$\frac{3}{32}$"
Q	3"	2"	1"

Compressed Air Consumption and Volume Delivered for Various Sized Nozzles

Nozzle Dia In.	Compressed Air Cu ft. Free Air per min	Volume Delivered 200 ft. of Ventube
$\frac{1}{8}$"	25-	
$\frac{3}{16}$"	44	2100
$\frac{1}{4}$"	54	2700
$\frac{3}{8}$"	100	3200

Accompanying Report by Herbert A. Franke.

"A jet of compressed air is released through the nozzle and directed into the cone at the intake end. In its passage through the constricted section it draws outside air into and through the tube. A well-designed blower of twelve-inch diameter will draw sixty times as much outside air as the quantity of compressed free air used.

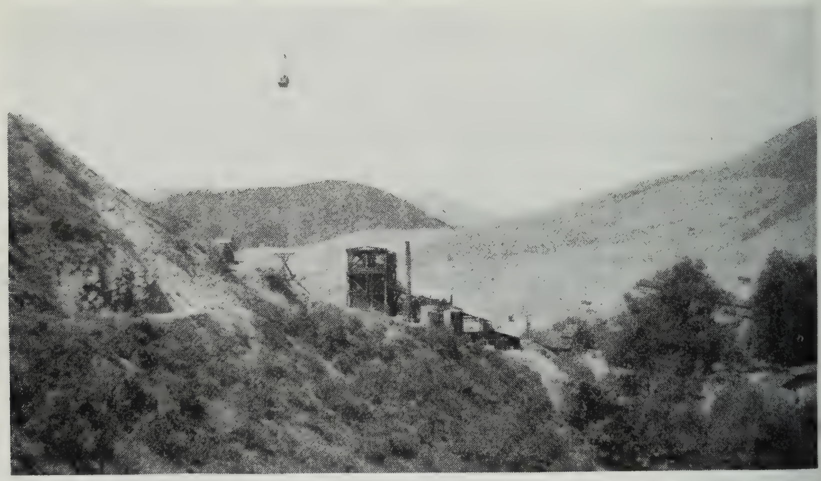


FIG. 5. Reduction plant of Oceanic Quicksilver Mine, San Luis Obispo County.

"The blower is provided with attachment hooks to fasten to wire supports, and also with a crimped collar at the discharge end to fit into the ventilation pipe.

"The blower is well adapted as a line booster in that it can be easily and conveniently placed in a ventilation pipe-line at any point. When so connected it will boost an otherwise exhausted flow of air hundreds of feet, depending on the size of pipe used and the compressed air pressure. The Injector Blower can be made in any sheetmetal shop at small cost."

Pine Mountain Group. These holdings, in Secs. 3, 10, and 11, T. 26 S., R. 8 E., have been idle for years, and are now part of the cattle ranges of the Hearst Estate, San Simeon.

Bibl: State Mineralogist's Reports VIII, p. 531; X, p. 580; XV, p. 718; XXI, p. 534; State Mining Bur. Bull. 27, pp. 163–165; Bull. 78, pp. 146–147.

Polar Star Mine (also called *Santa Clara* or *Black Hawk*). This property is situated in Sec. 13, T. 25 S., R. 6 E., in the canyon of San Carpojaro Creek, 3 miles above its mouth and 15 miles north of San Simeon. Walter Harris, Paso Robles, owner. E. D. Rodgers, San Simeon, recently leased the property and has been working it since June, 1935. He is commencing two crosscuts into the hillside in an attempt to locate the early workings, said to have been made by Mexicans. The property had been worked sporadically since 1870 by various owners, the earlier operations being confined to retorting float material. Between 1890 and 1900, E. S. Rigdon and others tried hydraulicking in an attempt to expose a vein. Rodgers is retorting some material, said to be float ore and ore from the old dumps, in a 2-pipe 'Rossi' retort. About a flask of quicksilver per week, or ten pounds a day, is being produced. Three men are working.

North Star Mine (*Santa Maria*) is reported to be included in this property owned by Walter Harris.

Bibl: State Mineralogist's Reports X, p. 581; XII, p. 366; XV, pp. 712–718; XXI, p. 534; State Min. Bur. Bull. 27, pp. 162–165; Bull. 78, pp. 140–147.

Quien Sabe (formerly *Doty Group.*) This group of five unpatented claims in Sec. 14, T. 26 S., R. 8 E., was reported in litigation. Joe Bianchi, Cambria, owner. Idle.

Bibl: State Mineralogist's Report XV, pp. 706–719; XXI, p. 531; State Mining Bur. Bull. 27, pp. 156–165; Bull. 78, p. 133.

Rinconada Mine (also called *San Jose Valley Mine*). Mrs. Theresa L. Bell, 157 Ronada Ave., Piedmont, and Mrs. C. B. Claus, Santa Margarita, owners. This property, like the Deer Trail, is quite apart from the main quicksilver belt of the county. It consists of eleven claims in Secs. 21 and 28, T. 30 S., R. 14 E., M. D. M., about 11 miles southeast of Santa Margarita. The mine was located in 1872, and was worked by various owners in the past who are said to have produced considerable quicksilver by working the rich surface exposures and outcrops. In 1876 it was equipped with a special sheet-iron type of furnace which did not work well. Two benches of 10-pipe retorts were put up in 1897. The property laid idle for a long time until after the World War. A rotary furnace and other equipment were placed on the property while sub-leased to the Santa Lucia Mining Corporation. Operations shut down after two trial runs, but the property was again sub-leased to the same corporation in 1923. The Santa Lucia Mining Corporation did considerable work, overhauling, changing, and making some innovations in the reduction plant. They are reported to have shut down the mine in 1925, after failing to satisfactorily solve the treating problem of the ore. The Mercury Corporation of America, a Nevada corporation, acquired the mine in 1928. Officers of this company were W. M. Dowsing, President; S. S. Rapp, Vice President; and John G. Bryson, Secretary-Treasurer. This company added new equipment and did considerable development work. On October 31, 1930, fire destroyed the mill and plant but they were immediately rebuilt, electrically equipped. The mine's production averaged about 85 flasks of quicksilver monthly when in full operation. This company ceased to operate about October, 1932, due to dissatisfaction among the operators. Some of the interests thought the mine should be operated on a much larger scale to realize a profit. One idea was to mine the ore disseminated through the hill by steam shovel, and concentrate the ore. E. J. Bartels of Kilgore, Texas, and associates spent about $16,000 in developing the mine and improving the plant, commencing in July, 1934. C. D. Richardson was superintendent. Mr. Bartels found another property and stopped operations about October, 1934.

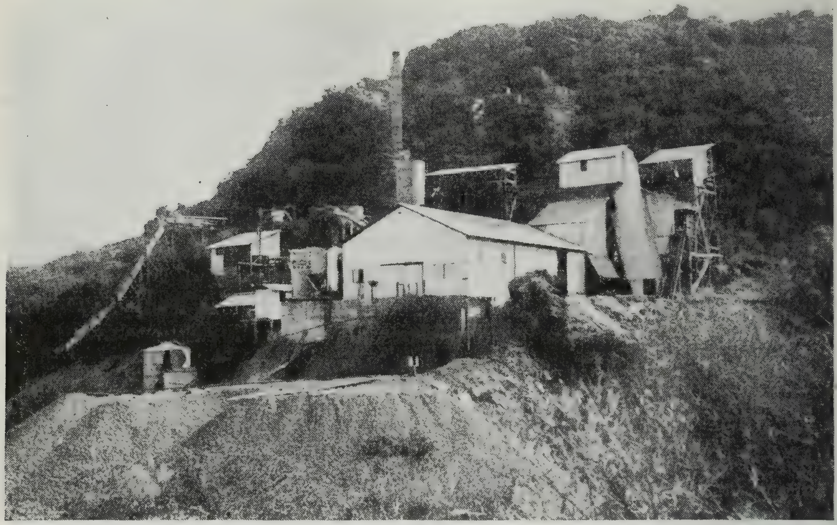


FIG. 6. Quicksilver reduction plant of Rinconada Mine, near Santa Margarita.

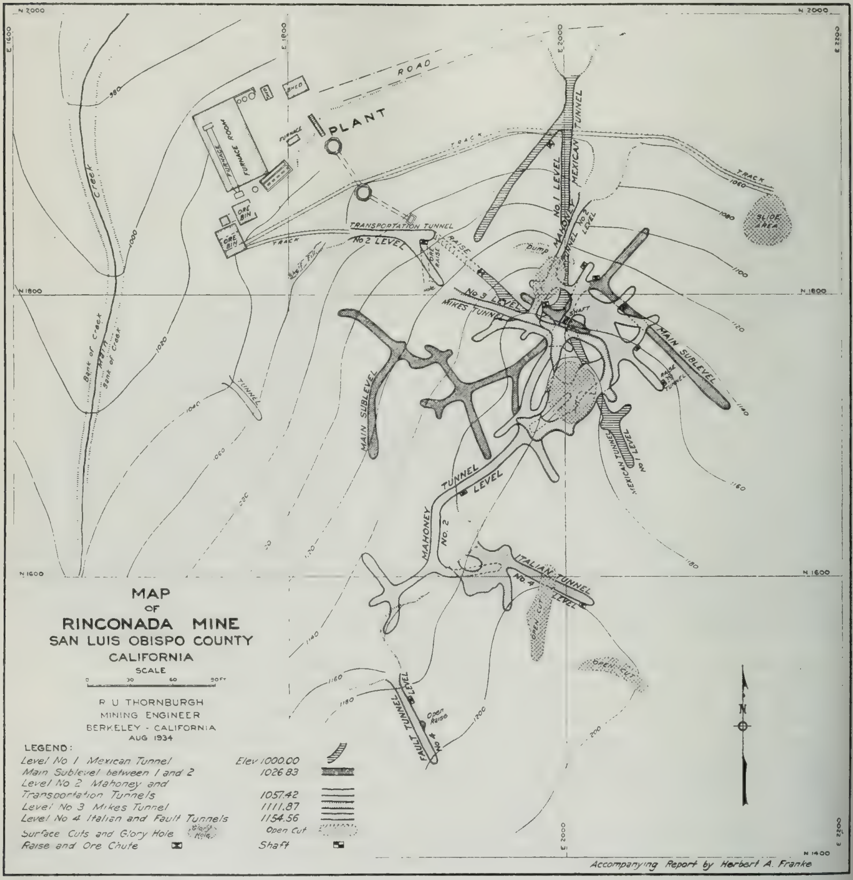
Photo by Walter W. Bradley.

C. W. Erickson took a lease on the property about the end of June, 1935, and had had the mill running only a few days when the property was visited (July 11, 1935).

The present operators plan to take most of their ore from the glory hole, which had been previously developed by the Mercury Corporation of America from two former intermediate adits, 40 ft. and 25 ft. The ore was being delivered to the 400-ft. adit (apparently the former main sub-level) by gravity, stored in an inside 50-ton storage bin, hand-car trammed to the adit portal about 200 ft., where the loaded ore car was hoisted on a 45° inclined track 75 ft. by an Ingersoll-Rand Utility hoist (tugger). From the top of the incline the ore was trammed about 200 ft. to the primary ore bin, and there screened through a grizzly. The oversize went to a crusher bin, and was crushed to 1½ to 2-inch size by a high-speed 14-inch by 10-inch Los Angeles jaw crusher. The fine and crushed material was elevated to a feeder bin. The total capacity for the three ore bins is 200 tons. From the feeder bin the ore was fed by a bumper to a 4-ft. by 54-ft. rotary furnace, with a specially patented firebox and burner designed by Erickson. A heavy crude oil, obtained at the Santa Margarita pumping station of the Union Oil Company for 90¢ a barrel, was used to fire the rotary. A maximum of 6½ gallons of oil per ton of ore and a minimum of 4 gallons to the ton is said to be required for the furnace.

The furnace gases were taken by a Sturtevant 10-inch by 14-inch suction blower from the rotary through a Sirocco cyclone. It recovered from 1½ to 2 tons of fine dust daily. Difficulty was encountered in separating the dust from the fumes. The gases went through a cooling chamber, an iron tube, 10 ft. high and 4½ ft. in diameter, equipped with one baffle. Erickson planned to discard this cooling chamber later. This was followed by two units of condensers, consisting of over 560 ft. of 18-inch cast-iron pipe, cooled on the outside by water sprays. Two 22-inch terra cotta pipes took the gases from the vertical pipe condensers to two 10-ft. by 22-ft. redwood tanks and to a wooden pipe stack. Erickson emphasized the importance of temperature recordings in an efficient reduction plant, having installed a Brown electric recording-pyrometer. This instrument records the temperature of the gases on leaving the furnace and on entering and leaving the condensers, every half minute. The temperature at the Sirocco cyclone discharge was 600° F., on entering condensing system, 360° F., and on leaving last condensing pipe, 90° F. The gases left the stack at approximately atmospheric temperature. Besides the equipment already mentioned the plant had two compound Chicago Pneumatic high-speed compressors, 13½ by 8 by 10, and 9 by 8, and General Electric motors with a total connected load of 200 h.p. Approximately 50 tons of ore were being treated per 24 hours when the plant was visited. Since that date Mr. Erickson has abandoned the mine (July 26, 1935), reported to be due to death in the family and also due to the fact that the grade of ore was too low to profitably operate at the present price of quicksilver. The short duration of this operation did not permit a thorough trial. A total of 9 men were employed, including 6 underground and 3 on top.

The country rock is mainly serpentine. The ore is low grade, probably averaging 3 or more pounds per ton, but with some occasional very high-grade streaks of cinnabar. Former operators state that the high-grade appearance of the ore is deceiving. The ore is disseminated, usually occupying cracks in the rocks. Pyrite, calcite, dolomite, quartz, and organic matter accompany the ore. A general tonnage estimate made by a private engineer in 1934 on the main portion of the property stated that 816,500 tons of cinnabar ore, averaging three pounds, were available. Some samples of the ore are said to assay a little gold and silver. The Mercury Corporation of America confined their operations to the north side of the hill, which had not been greatly developed previously. The Fault and Italian tunnels were operated in the early days. The upper tunnel, mentioned in Bull. 78, as 75 ft. long, is still caved and inaccessible. It has already been stated that the two former intermediate adits, 40 ft. and 25 ft., were caved into a glory hole. Considerable ore remains here. This glory hole extends from the surface, through Mikes tunnel, to a short distance below the Mahoney tunnel. A raise from the Mexican tunnel to the Mahoney was also


MAP
OF
RINCONADA MINE
SAN LUIS OBISPO COUNTY
CALIFORNIA
SCALE
0 30 60 90 FT
R U THORNBURGH
MINING ENGINEER
BERKELEY - CALIFORNIA
AUG 1934
LEGEND:
Level No 1 Mexican Tunnel Elev 1000.00
Main Sublevel between 1 and 2 1026.83
Level No 2 Mahoney and Transportation Tunnels 1057.42
Level No 3 Mikes Tunnel 1111.87
Level No 4 Italian and Fault Tunnels 1154.56
Surface Cuts and Glory Hole
Glory Hole
Open Cut
Raise and Ore Chute
Shaft
PLANT
ROAD
TRACK
FURNACE ROOM
FURNACE
SHED
ORE BIN
Creek
Main Creek
Bank of Creek
TRANSPORTATION TUNNEL
No 2 LEVEL
RAISE
ORE RAISE
No 3 LEVEL
MIKES TUNNEL
SHAFT
No 1 LEVEL
MEXICAN TUNNEL
MAHONEY TUNNEL
No 2 LEVEL
Dump
MAIN SUBLEVEL
RAISE TO TUNNEL
SLIDE AREA
TUNNEL
MAHONEY TUNNEL No. 2 LEVEL
MEXICAN TUNNEL No 1 LEVEL
ITALIAN TUNNEL No. 4 LEVEL
OPEN CUT
FAULT TUNNEL No. 4 LEVEL
Open Raise
N
N 2000
N 1800
N 1600
N 1400
E 1600
E 1800
E 2000
E 2200
980
1000
1020
1040
1060
1080
1100
1120
1140
1160
1180
1200
Accompanying Report by Herbert A. Franke

developed by the Mercury Corporation of America, revealing a rich ore shoot. This ore was removed, with the aid of a tugger hoist, from the Mahoney level.

In general, the development at the present time consists of: lower No. 1 level, 1000 ft. elevation; Mexican tunnel, which is about 300 ft. long, with two drifts, 105 ft. and 90 ft.; Main Sub-level, between Nos. 1 and 2, about 400 ft. long, with several hundred feet of drifting; No. 2 level, Mahoney tunnel, about 450 ft. long, with several hundred feet of drifting, and 100-ft. Transportation tunnel; No. 3 level, Mike's tunnel, formerly over 200 ft. in length which has mostly caved into the glory hole; and No. 4 level (southern part of property), 1154 ft. elevation, which includes the Italian tunnel, in about 100 ft.; and the Fault tunnel, in about 70 ft. The Italian and Fault tunnels are said to contain considerable ore but have not been developed because of their distance from the reduction plant. The Mercury Corporation of America had planned to connect these levels with the other workings for a transportation outlet, but their operations ceased before this could be realized. The ground in this mine stands without timber, and the open-stope and filled-stope mining methods have been used.

Bibl: State Mineralogist's Reports X, p. 581; XII, p. 366; XIII, p. 531; XV, p. 719; XXI, pp. 534–535; State Mining Bur. Bull. 27, p. 166; Bull. 78, pp. 147–148. U. S. Geol. Survey Mon. XIII, p. 381.

Warren Ranch, adjoining the Oceanic Mine, is owned by George and William Warren, Cambria. C. Kyte, Arroyo Grande, and F. A. Lindley, Pismo Beach, have a lease on 40 acres of the property, working three or four men about 3 months of the year. Cinnabar ore is disseminated over a wide area, and the present operators are trying to discover a vein by a series of open cuts. Several tunnels were driven into the steep hillside many years ago in search of an orebody in place, but no deposit of value was uncovered. A 40-pound jaw crusher and a 2-pipe 'Rossi' retort are used to reduce the float cinnabar ore into quicksilver when the property is in operation.

Bibl: State Mineralogist's Report XV, p. 720; XXI, p. 535; State Mining Bur. Bull. 78, p. 149.

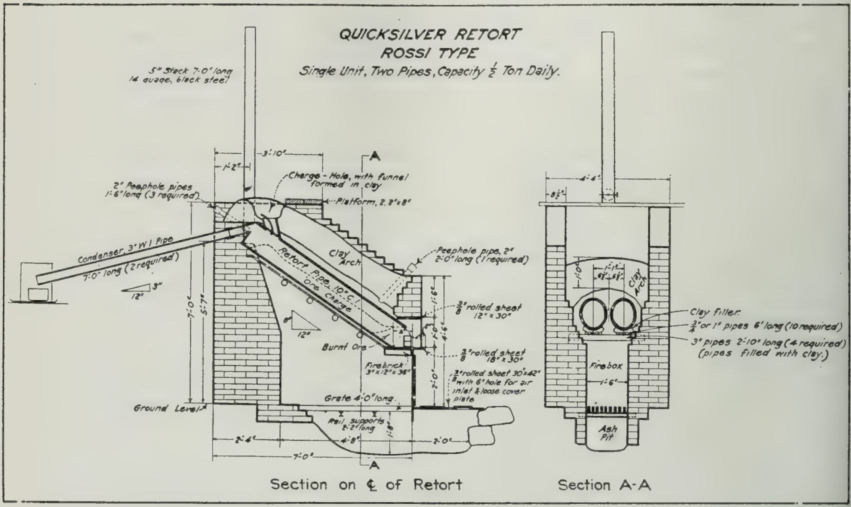
Wittenberg Mine in Sec. 8, T. 27 S., R. 9 E., near the Oceanic Mine, was prospected for a few months about three years ago, but is now idle. Peter Silacci, Cambria, owner.

Bibl: State Mineralogist's Reports XV, p. 720; XXI, p. 535; State Mining Bur. Bull. 27, p. 168; Bull. 78, p. 149.

There have been no changes noted at the *Kismet Group,* Sec. 7, T. 27 S., R. 10 E.; *Sunset View,* Secs. 13 and 18, T. 25 S., R. 6 E.; *Vulture Mine,* Sec. 24, T. 27 S., R. 9 E.; and *William Tell Mine,* Sec. 32, T. 26 S., R. 10 E., M. D. M. See State Mining Bur. Bull. 78, for references.

Rossi Type Quicksilver Retort. Louis I. Rossi, R. F. D., Box 168, Paso Robles, developed an inexpensive and efficient quicksilver retort with some new innovations while he was at the Klau Mine in 1927. Quite a number of small properties in San Luis Obispo County have erected this type of retort since then, reporting it to work satisfactorily. A drawing of a 2-pipe retort is shown herewith.

The 2-pipe retort is a unit complete with one firebox. The retort pipes are cast from heat-resistant alloy $\frac{5}{8}$ inches thick, 6 ft. 2 inches long, with a 10-inch inside diameter. Discarded pipes from a Johnson-McKay retort are said to be often used, opening one end for the lower-end discharge and the opposite upper side for the hopper, with the aid of an acetylene torch. The pipes are set on an incline, approximately 30°, and ore is charged through a hopper at the upper end. The charge half fills the pipe, which is closed at the lower open end by a plug of burnt ore stacked in such a way as to let a little air draw through it. Two bricks are used to help stack the burnt ore in plugging the lower end of pipe. Damp ashes and clay are used to pack around the charging hole at the upper end of pipe. The pipes are directly exposed to the fire in a box built so as to heat them evenly end to end. Quicksilver vapors are condensed in an 8-ft. pipe with a hood at the lower end and an iron pot to collect the quicksilver. This condenser pipe, 3-inch inside diameter, set on an incline of about 14°, is connected to the retort pipe with a 10-inch nipple.


QUICKSILVER RETORT
ROSSI TYPE
Single Unit, Two Pipes, Capacity ½ Ton Daily.

Section on ℄ of Retort

Section A-A

5" Stack 7'-0" long
14 guage, black steel
3'-10"
1'-2"
A
Charge - Hole, with funnel formed in clay
2" Peephole pipes 1'-6" long (3 required)
Platform, 2.2"x8"
Condenser, 3" W I Pipe 7'-0" long (2 required)
3"
12"
Clay Arch
Retort Pipe, 10" C.I.
Ore charge
Peephole pipe, 2" 2'-0" long (1 required)
7'-0"
5'-7"
1'-6"
6"
12"
⅜" rolled sheet 12" x 30"
4'-6"
1'-0"
Burnt Ore
Firebrick 3"x12"x36"
⅜" rolled sheet 18" x 30"
2'-0"
⅜" rolled sheet 30"x42" with 6" hole for air inlet & loose cover plate
Grate 4'-0" long
Ground Level
Rail supports 2'-2" long
1'-8"
2'-4"
4'-8"
2'-0"
7'-0"
4'-4"
8½"
1'-0"
1'-1"
6½"
6½"
Clay Arch
Clay filler
¾" or 1" pipes 6' long (10 required)
3" pipes 2'-10" long (4 required) (pipes filled with clay.)
Firebox
1'-6"
Ash Pit

All of the retorts of this type that were in use at the time of visit were using wood for fuel. The fuel consumption is said to be exceptionally low, using one-third of a cord of wood per ton of ore. Gas, oil, or coal may be used. Banks of more than two pipes can be made. A 6-pipe bank should be made by lining up three units of two pipes each, all in a single frame, but with three fire boxes. A 10-pipe bank can have one large firebox and a set of flues with dampers passing under and over the pipes. The retort frames are made partly of masonry with an inside liner of common brick. The retort could partly be built into the side of a hill to save masonry.

The capacity of a 2-pipe retort is said to be one-half ton of ore daily. The recovery is said to average over 90% when firing is properly done. The pipes are charged and the fires stoked every six hours, or four times daily. No attention is necessary for the small unit retorts between times.

The advantages claimed for the Rossi retort are: Quicker and more complete reduction of the ore, because of the slope of the pipe and the natural draft from pipe to condenser; less soot, crust or mud and cleaner mercury, because the air inlet provides enough oxygen to combine with sulphur vapors which then pass out as dioxide; and more safety from gases because they can escape only at the condenser end. It is also said to be especially adaptable in treating quicksilver ores containing pyrite.

SODIUM SULPHATE

William C. Hay, Ltd. (formerly Consolidated Chemical Co., Pacific Distributing Corp.) This sodium sulphate deposit, in the form of Glauber's salt, $Na_2\ SO_4\ 10\ H_2O$, occurs in T. 31 S., R. 20 and 21 E., in what is known as Soda Lake. Soda Lake covers an area of 2800 to 3000 acres. The lake receives the drainage of the Carrizo Plain and has no outlet. The Carrizo Plain is a structural depression which has been faulted down between the Caliente and Temblor ranges. Evaporation exceeds the rainfall of the area, and the lake is dry except after heavy storms, and its surface is covered with a broad layer of white crystalline salts, ranging from a thin sheet about the margins to a deposit a few inches thick in the deeper parts. There are also some deep channels that have been filled. Beneath the surface crust of mirabilite crystals (Glauber's salt) there is a greenish-gray mud, containing some crystal salts and saline matter in solution. Some bloedite crystals, a hydrated double sulphate of sodium and magnesium, are also found in this mud. Gale[1] estimated that over a million short tons of sodium sulphate (crude salts) were available in this deposit.

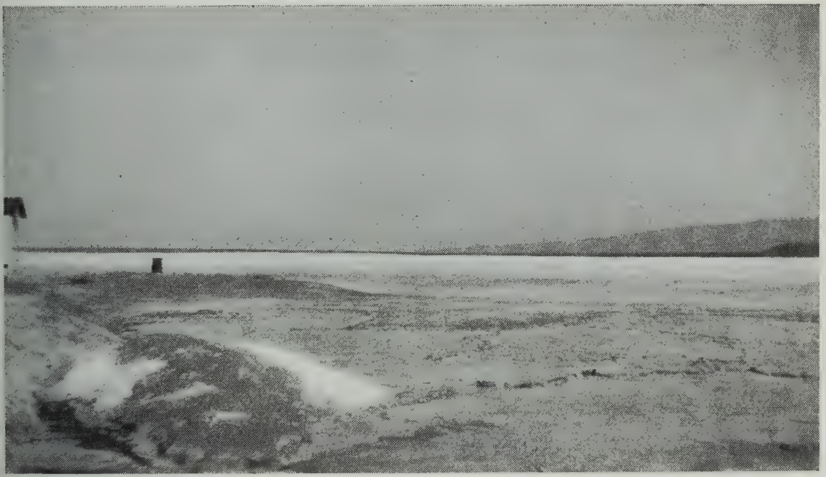


FIG. 7. A portion of Soda Lake, Carrizo Plain, San Luis Obispo County.

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[1] Gale, Hoyt S., U. S. Geol. Survey Bull. 540, p. 428.

An analysis of the material as given in Canada Department of Mines Bulletin No. 646 shows:

	Per cent
Insoluble in water (clay and sand particles)	0.91
Soluble in water—	
Lime (CaO)	0.34
Magnesia (MgO)	1.00
Soda (Na_2O)	38.72
Sodium Chloride (NaCl)	5.95
Sulphur trioxide (SO_3)	50.83
Moisture	2.65
Total	100.40

A combination possible from the above analysis may be calculated as 88.71 per cent anhydrous sodium sulphate.

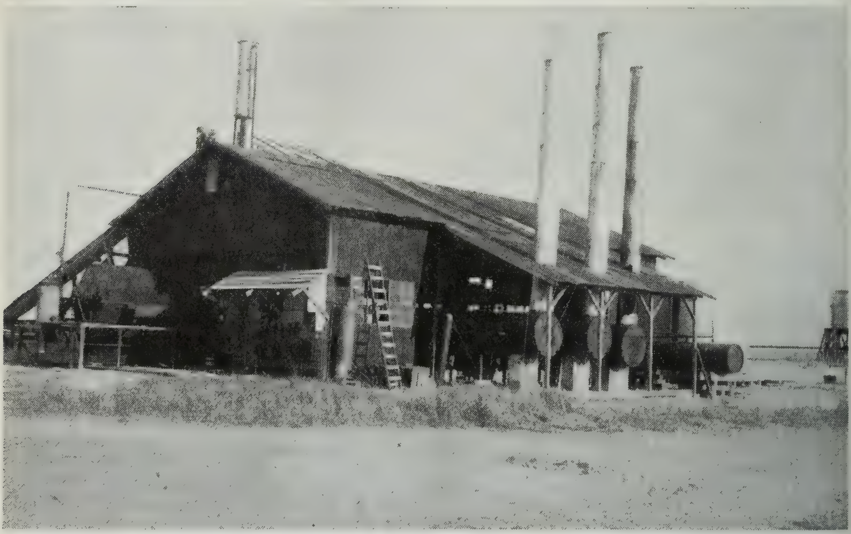

FIG. 8. Plant of William C. Hay, Ltd., for processing sodium sulphate, Soda Lake, San Luis Obispo County.

William C. Hay, Ltd., 8511 West Third St., Los Angeles, are the present owners of this deposit and plant. C. L. Burt, 309 South Holt Ave., Los Angeles, is foreman. The plant was dismantled and moved from the south side of Soda Lake to the opposite side of the lake in 1934. The plant was operated at its new location for a few months when it was closed down. At the present time some experimental work is being carried on. One man is employed to do this work and take care of the property. Water was pumped into a small section of the lake to dissolve the crude salts, and the brine then pumped into two new earthen settling-tanks, about 80 ft. square and 40 inches deep, for solar evaporation. The plant equipment includes three oil-fired boilers, filter, Fairbanks-Morse D. C. Generator, 90-h.p. Whiton turbine, and a number of motors and pumps. The narrow-gauge railroad tracks previously built on the lake were removed several years ago. The crude salt was crushed, washed, dried in centrifugals, sacked, and hauled to McKittrick by auto trucks in the 1923–1925 operation.

Plans are to commence operating the new plant in the near future. The limited market for 'salt cake' (the trade name for anhydrous sodium sulphate), and the long haul of 28 miles over the Temblor Range to McKittrick, the nearest shipping point, makes exploitation difficult. It has been said that there is a rising trend in the demand for sodium sulphate, which is mainly used in the pulp and paper industry, glass industry, nickel refining, textile dyeing, tanning industry, paint and varnish industry, in electro-chemistry and electro-plating, in medicine, and in the chemical industry.

Bibl: State Mineralogist's Reports VIII, p. 532; X, p. 563; XV, p. 127; XVII, p. 386; XXI, pp. 535–536. State Min. Bur. Bull. 24, p. 136. U. S. Geol. Survey Bull. 380, p. 369; 540, p. 428. U. S. Bur. of Mines, I. C. 6833. Canada Dept. of Mines Bull. 646, p. 20.

STONE INDUSTRY

Crushed Rock, Sand and Gravel.

County Sand and Gravel The county of San Luis Obispo obtains considerable sand and gravel for the construction of roads and county buildings from the beds and mouths of various rivers and creeks. Some of these streams are: Salinas and Nacimiento rivers; Estrella, Huer-Huero, Arroyo Grande and Los Berros creeks; and from the mouths of Morro, Toro, Cayucos, Santa Rosa and San Simeon creeks, where they empty into the ocean.

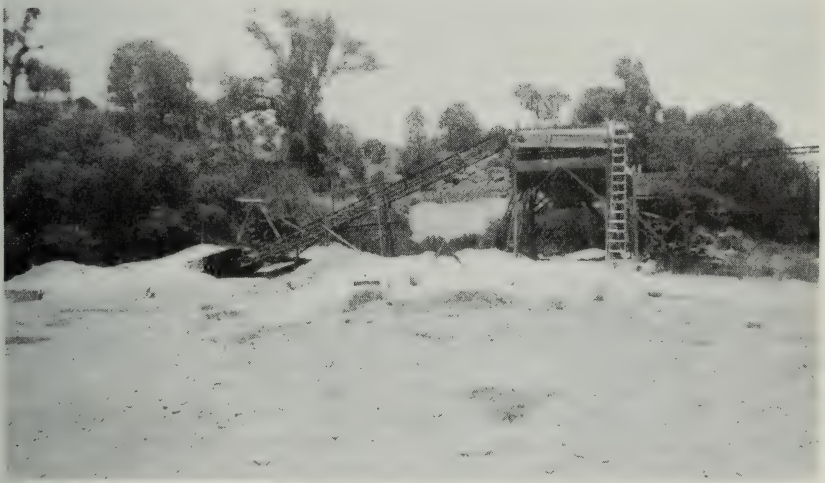

FIG. 9. Portable sand and gravel plant belonging to county of San Luis Obispo on Salinas River.

A portable sand and gravel plant was moved from Arroyo Grande Creek to the bed of the Salinas River, about 10 miles southeast of Santa Margarita, in April, 1935. This plant operated from April until June, supplying material for the construction of the new county courthouse in San Luis Obispo. A four-cylinder Fordson tractor, rigged with cable wheels to pull a drag-line scraper, delivered the sand and gravel from the river bed on to a rubber conveyor belt, which elevated the material up to the trommel. The trommel screened two sizes of fines, which fell directly into a two-compartment 15-cu. yd. Western loading G bin, from which the sand was loaded into automobile trucks. The coarse rock rejected at the end of the trommel was crushed by a jaw-crusher, driven by gasoline engine. The crushed material was then lifted by means of a bucket conveyor and again run through the trommel.

Gularte Plant. This sand and gravel property is located on the bank of Salinas River, about two miles west of Pozo. A drag-line scraper, operated by a Stutz gasoline-engine hoist, takes the material from the river bed and delivers it to a hopper. The sand and gravel is then lifted 16 ft. by a conveyor bucket line to a 3-ft. by 10-ft. trommel. The washed and screened material is lifted 32 ft. by bucket conveyors to another trommel, 3 ft. by 8 ft., from which the fines empty into a two-compartment storage bin. The coarse rock is crushed to ½-inch size by a jaw crusher and is then screened by the two trommels. A 40-h.p. Best tractor is used in driving the conveyors and trommels. The plant is able to produce better than 80 cu. yds. daily. Two men are employed when in operation. M. Gularte, Santa Margarita, is owner.

Roselip Rock and Sand Plant. This rock, sand and gravel property is located at the confluence of the Salinas River and Santa Margarita Creek, about four and a half miles north of Santa Margarita, on the Sandoval county road. The sand and gravel from the stream bed is delivered to a hopper by means of a drag-line scraper, operated by a gasoline engine. The material passes through a trommel, the coarser rock being rejected at the trommel's end and later crushed. Gilbert conical, tapered screens and a continuous flow of water washes all sediment from the sand and rock. The daily capacity of this new plant will be 150 tons of rock or gravel and 100 tons of sand. Walter B. Roselip, owner.

Southern Pacific Quarry. This quarry and rock-crushing plant, owned by the Southern Pacific Railroad for supplying its own needs, is situated in Calf Canyon, about 3 miles northeast of Santa Margarita. The rock is a coarse-grained granite, which is broken in large blocks for rubble and rip-rap. The plant has not produced any material for the past two years and some of the equipment has been removed.

Bibl: State Mineralogist's Report XXI, p. 537.

Templeton Sand Plant, situated on the banks of Salinas River at Templeton near the Southern Pacific tracks, has been shut down for some time. Sand was taken from the river bed by drag-line bucket. Some of the equipment still remains at the plant. It was last owned by the Granite Rock Company of Watsonville.

Bibl: State Mineralogist's Report XV, pp. 725–726; XXI, p. 535.

Building Stone.

Bishop's Peak Quarry. This property is located in Sec. 21, T. 30 S., R. 12 E., about three miles west of San Luis Obispo, on the side of Cerro Obispo. Granitic rock from this location was used as a building stone and in foundations many years ago. Walter B. Roselip, 615 Grand Ave., San Luis Obispo, has taken a lease on the property at the present time, and expects to commence operations soon. The rock will be crushed and used as construction material. It is an andesite granophyre of dark-gray color and subconchoidal fracture.

Bibl: State Mineralogist's Report XV, p. 722; XXI, p. 537. State Mining Bureau Bull. 38, p. 153. U. S. Geol. Survey, San Luis Folio 101.

Caen Quarry, formerly operated in Sec. 36, T. 32 S., R. 13 E., M. D. M., and in Sec. 26, T. 12 N., R. 35 W., S. B. M., is probably the same rhyolitic tuff material as described under Fugler Quarry.

Fabbris-Carpentier Co., Ltd., 275 Bush St., San Francisco, formerly *A. Carpentier and Empire Trading Co., Inc.,* quarried some of the rhyolitic tuff that is found between Arroyo Grande and Santa Maria several years ago.

Fugler's Quarry. This quarry is located on Los Berros Creek, about 9 miles northwest of Santa Maria, on property owned by A. F. Fugler, Santa Maria. The material is a yellow or cream-colored altered rhyolitic tuff, which outcrops at a number of places on the bluffs of Los Berros Creek, northeast of the Coast highway. L. N. Crawford, architect of Santa Maria, used this stone for the interior decorating in the entrance of the new Santa Maria City Hall. The stone for this project was quarried in about six weeks time in 1934. It was quarried in large blocks and sent to the California Cut Stone Granite Co., South San Francisco, to be cut into dimension stone. A boom and gasoline-engine hoist was used in working the deposit.

This rhyolitic tuff has been used a little for buildings in Arroyo Grande, San Luis Obispo, and Los Angeles in the past. It is also said to have been ground and burned several years ago and used in the coloring of plaster and in kalsomining.

Lee Quarry, in Sec. 17, T. 30 S., R. 12 E., M. D. M., on the north side of Cerro Romaulda, is said to have furnished a rock similar to the material from Bishop's Peak. It has been idle for a long time.

Moore Quarry, in Sec. 31, T. 12 N., R. 35 W., S. B. M., near Los Berros, probably furnished stone similar to Fugler's Quarry, when in operation many years ago.

Mora Brothers Quarry. This flagstone deposit, covering about 11 acres, is located 10 miles east of Cambria, on the Cambria-Paso Robles road, and on Santa Rosa Creek. The material is a sandstone, and it is said to contain some oil shale. R. A. Mora, Box 121, Cambria, the owner, commenced operating the property in 1930. The sandstone is so bedded that its thickness is correct for use as a building stone, and it is pryed loose from the deposit with the aid of a crowbar. The slabs are then shaped with a hammer and stacked on an automobile truck for shipment. Some 6-ft. by 4-ft. slabs, or larger, are often pried loose. Mora Brothers have produced about 350 tons of this stone. Two or three men are employed when working. W. R. Hearst is said to have previously used about 200 tons of this flagstone on his ranch at San Simeon.

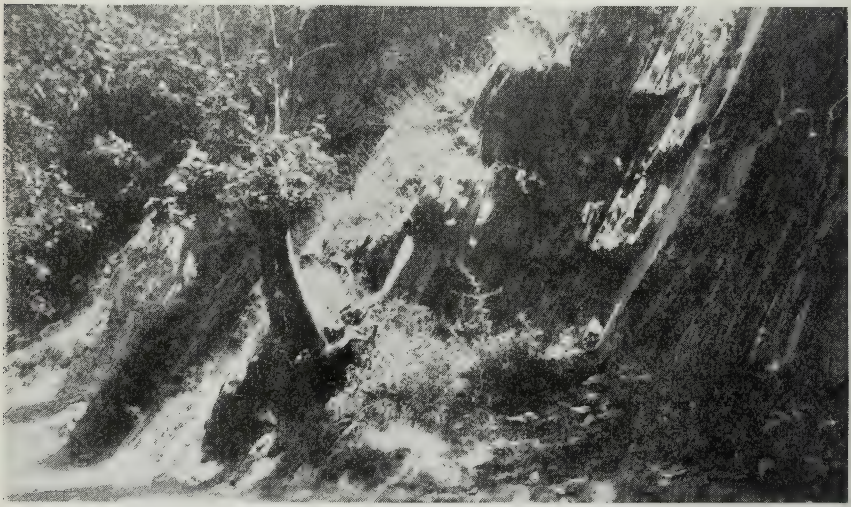

FIG. 10. Flagstone deposit, Mora Brothers Quarry, San Luis Obispo County.

Morro Rock, an island at the entrance of Morro Bay, is the outermost butte of the line of igneous masses extending northwesterly from below San Luis Obispo to the ocean. Its rock is classified as dacite-granophyre, Cretaceous in age. This stone is now being quarried for use in the construction of the breakwater at Port San Luis. The quarry covers 40 acres near the water line and is 576 ft. high. M. D. Gaines is in charge of operations. Morro Rock is now a State Park.

Bibl: State Mineralogist's Report XV, pp. 722–724; XXI, pp. 536–537; State Mining Bur. Bull. 38. U. S. Geol. Survey, San Luis Folio 101.

Reynolds Quarry. This flagstone deposit is situated about 7 miles southwest of Paso Robles. The material is quarried by hand, using crowbars, hammers and chisels. Ornamental stone, as well as flagstone, is produced by the owner, Thomas C. Reynolds, Route 1 A, Box 53, Paso Robles.

Santa Rita Grade is about 13 miles northeast of Cayucos. Some flagstone was produced from this quarry several years ago.

Flagstone is also reported to have been quarried in Lopez Canyon, northeast of Arroyo Grande, on property belonging to Elena Rodriguez, Arroyo Grande. Another deposit is located 7 miles northeast of Morro, on Little Morro Creek.

VOLCANIC ASH

Grey Eagle Mine and Black Eagle Claims, formerly *Francis Cleaner Mine* and *Golden State.* This property comprises 160 acres in Secs. 21 and 22, T. 28 S., R. 15 E., M. D. M., about 10 miles southeast of Creston. This large deposit of indurated white volcanic ash, interbedded with siliceous shale and sandstone, was first discovered by the present owner, M. L. Francis, Creston, in 1923. The deposit probably covers about 40 acres and the owner estimates a potential tonnage of over two million tons. Only a small amount of overburden covers the deposit. The formation strikes NW.-SE. and dips about 30° to the north. The deposit has been developed by a 60-ft. and a 40-ft. tunnel, and two other shorter tunnels. The layer of volcanic ash seems to be from 40 to 50 ft. thick. A fossil leaf found in the deposit has been identified as *Persea pseudo-carolinensis,* of Miocene age.

Dynamite is used to loosen this compact material in mining. The large pieces of volcanic ash are then ground with a small hammer-mill of the owner's own design, passed through a 40-mesh wire screen, and sacked in various sized quantities. The mill is driven by a gasoline Oldsmobile 4-cylinder engine. The ground material is sold as a polishing powder and soap by house-to-house canvassing. It is a high-grade volcanic ash and users say that it is very satisfactory but the owner lacks capital to handle it on a large scale. The deposit is at an elevation of about 1500 ft. and is easily accessible. Santa Margarita, the nearest railroad station, is 18 miles distant. A water supply is lacking, but could be developed by a well.

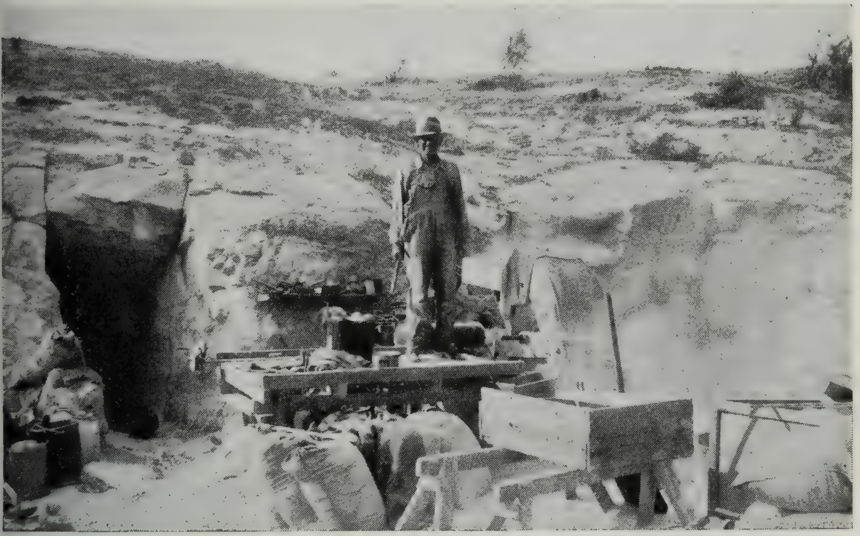

FIG. 11. M. L. Francis grinding volcanic ash at his Grey Eagle Mine, San Luis Obispo County.

Bibl: State Mineralogist's Report XXI, pp. 537–538.

A very fine volcanic ash deposit, once thought to be diatomite, in Sec. 23, T. 26 S., R. 10 E., near Adelaida, was worked for a time in 1880, the material being sold as 'Magic Polish.' The bed here is reported to be six feet thick and to cover 25 acres.

MINERAL RESOURCES OF PORTIONS OF MONTEREY AND KINGS COUNTY

By HERBERT A. FRANKE, Junior Mining Engineer

When the writer visited San Luis Obispo County in July, 1935, information on the activity in the *Parkfield quicksilver district,* Monterey and Kings counties, was obtained from Henry Twisselmann of San Miguel, and a short visit was made to the *Los Burros gold mining district,* Monterey County.

Parkfield District—Quicksilver.

The following properties are reported active near Parkfield:

Patriquin Quicksilver Mine (one time called *Pitt;* also *Cholame-Parkfield;* and *Parkfield*) in Sec. 2, T. 23 S., R. 14 E., is being opened up by Rowe and Zimmerman. They are running tests with pipe retorts. A Gould rotary furnace installed at the mine a few years ago is not now in use. Three men are working. No production was reported for 1934 and 1935 to date.

Friedana Mine, also called *Anderson,* said to have been the former *Table Mountain Claim,* in Sec. 30, T. 23 S., R. 16 E., is now being operated by E. K. Anderson and H. Boyd, Parkfield. F. R. Radcliffe, Parkfield, owns the property. The operators are installing a concentrating table and also plan to install a 15-ton jaw crusher. Pipe retorts are used. The property produced quicksilver in 1934 and 1935. Five men are employed.

Dawson Pit Mine, in NW$\frac{1}{4}$, Sec. 28, T. 23 S., R. 16 E., has just started production of quicksilver, using pipe retorts. A concentrator is being installed. Three men are employed. Frank Coerella, Parkfield, is the operator.

Bibl: State Mineralogist's Reports XIV, pp. 528–530; XV, pp. 613–614; XXI, pp. 50–53; XXVI, pp. 421–422; State Mining Bur. Bull. 27, pp. 122–125; Bull. 78, pp. 50–52, pp. 73–75.

Los Burros District—Gold.

The Los Burros District is situated in the southwestern part of Monterey County, in T. 23 and 24 S., R. 5 E., M. D. M., (U. S. G. S., Cape San Martin Quadrangle). It may now be reached by rough mountain road from the new scenic Roosevelt highway, being built from Monterey to Morro Bay. At the present time one must go up this highway from the southern end, via Cambria and San Simeon, turning right to the Los Burros District in the vicinity of Cape San Martin.

The district is estimated to have produced over $150,000 in gold from the years, 1888 to 1915, inclusive. The geology of the area was described in U. S. Geological Survey Bulletin 735, pp. 323–329, and the mines are described in various State Mineralogist's Reports, the latest being the XXI Report, pp. 37–41, January, 1925. The writer found development work going on at some of the properties, in July, 1935, which will be briefly mentioned. The author is indebted to J. W. Krinkel, who lives in the district, for much of this information.

Brewery Mine, in Sec. 2, T. 24 S., R. 5 W., probably abandoned.

Brooklyn Mine, in Sec. 2, T. 24 S., R. 5 E., relocated by Wm. Cruikshank, Los Burros, San Simeon P. O., California.

Buclimo Mining Co. owns a number of claims in this district, mainly in Sec. 2, T. 24 S., R. 5 W. The *Last Chance* claim, in this group, was discovered by W. D. Cruikshank in 1887, and led to the development of the gold veins of the district. Some placer mining had been done in the area prior to that time. The *Last Chance* was developed on a considerable scale and is usually referred to as the Buclimo mine. The 1800 ft. crosscut tunnel referred to by J. M. Hill[1] in 1921, is said to be 1860 ft. long, according to J. M. Krinkel, caretaker of the property. It is stated that this tunnel should be driven 600 ft. to reach the vein. The hoist building at the mine has partly fallen in, and the old mill needs repairing. It is equipped with a 5-ft. Huntington Mill and accessories. A. H. Wilhelm, 666 Mission Street, San Francisco, is president of the Buclimo Mining Co.

Bushnell Mine is owned by George Miller, Los Burros, San Simeon P. O., California. Some development work is being done. It is equipped with a one-stamp mill.

Condor Group of four claims adjoin the M. M. Mine. Wm. McPhie, Berkeley, owner.

J. C. and Raymond Gillis are working placer ground on Spruce Creek.

Gorda Mine, in Sec. 4, T. 24 S., R. 5 E. Idle.

Hammond Claims are said to have been relocated by H. Melville, Palisade and Pinnacles, California.

Wm. Kenner and brother, Templeton, located a quartz claim in 1934 near the confluence of the north and south forks of Willow Creek. The ore is said to have run $30 in gold and $6 in silver. *Benn and Smith* are reported to have located two placer claims in the same vicinity in 1934.

Lucky Jim Placer and Quartz Claim has been located about one-half mile from the mouth of Plaskett Creek by J. C. Krinkel.

Manchester (*Blue Jay*), owned by S. O. Pugh, Gorda, California. Idle.

Mariposa Mine, in Sec. 2, T. 24 S., R. 5 E., is said to be owned by S. O. Pugh of Gorda, and J. C. Lozier.

M. M. Mine (*Melville*). This property consists of 14 claims owned by H. and Kenneth Melville, Palisade and Pinnacles, via Soledad, California. They are located on Gold Ridge between two forks of Willow Creek, and appear to be a continuation of the Buclimo lode. Two tunnels, 40 and 60 ft. in (now partly caved), were driven in a crushed-ore zone, containing stringers of quartz, and having a width of 10 ft. or more. The owners plan to run a 275-ft. tunnel below these workings. The crushed ore is said to carry some gold.

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[1] Hill, J. M., The Los Burros District, Monterey County, California. U. S. Geol. Survey Bull. 735-J, 1923.

New York Mine, in Sec. 1, T. 24 S., R. 5 E., on Ajax Mountain, is owned by the New York Mining Co., a private company, composed of Wm. Cruikshank, Los Burros, San Simeon P. O., and Donald and J. C. Lozier, Gonzales, California. Mr. Cruikshank is now driving the lower crosscut tunnel, 200 ft. below the outcrop, toward the footwall ledge. A previous report states a vein 3 to 4 ft. in width, carrying good values over a width of 20 inches to 3 ft. or more, was cut on this level when in 440 ft. Chas. McWaters, who had recently leased the property, milled 75 tons of ore this spring. A Straub mill with amalgamating plate and Overstrom table, driven by gasoline engine, are on the property. The present values are in the form of sulphides, which carry very little silver. The new coast highway and road into the district enables the concentrates, which previously had to be packed over trail to Jolon, to be taken to San Simeon by automobile.

Oregon and Cool Springs Claims, adjoin the Mariposa Mine, and are located in Sec. 2, T. 24 S., R. 5 W., at an elevation of 2700 ft. J. M. Krinkel, Los Burros, San Simeon P. O., California, owner, states that the ore averages about $11 per ton in gold, based on the old price of $20.67 per ounce. Considerable work has been done in the course of assessments.

Plaskett Mine (*Ocean View, Howard Mine*), is located in Sec. 30, T. 23 S., R. 5 E., at an elevation of about 900 ft. The owner, L. M. Plaskett, is reported to work the mine occasionally, and has made a new find in recent developments.

Sandall Property, in Sec. 35, T. 23 S., R. 5 E., has been relocated by a Mr. Henderson of Paso Robles.

Substantial, Providence, Existence Placer Claims; Olivine, One Dollar, Prince Bismark Quartz Claims and tunnel site, are located in Sec. 4, T. 24 S., R. 5 E., and Sec. 33, T. 23 S., R. 5 E. Ernest Bauman, Los Burros, San Simeon P. O., California, said that he commenced working this property in October, 1931. He states that the lowest No. 1 tunnel on Olivine claim, in 200 ft., crosscuts a 3-ft. vein composed of black talc and quartz. This vein has been drifted on for 16 ft. Free gold and sulphides are panned from the quartz. The hanging wall is said to be slate and sandstone, with a slate footwall. No. 2 tunnel on the Providence claim has been driven 110 ft. There are two crosscut tunnels, 76 ft. and 50 ft. long.

Toro Claim is owned by J. Wallace Mathers, Los Burros, San Simeon P. O., California. He had sunk a shaft 25 ft. at the time of visit. The hoist consisted of a windlass mounted on a low wooden headframe. Development also includes two tunnels, one in 60 ft.

Bibl: State Mineralogist's Reports VIII, pp. 405–410; XI, pp. 259–262; XII, p. 184; XIII, p. 234; XV, pp. 602–605; XXI, pp. 37–41. U. S. Geol. Survey Bull. 735, pp. 323–329. Mining and Scientific Press, Vol. 104, pp. 696–698, 1 fig. May 18, **1912.**

LOS ANGELES FIELD DISTRICT

W. B. TUCKER and R. J. SAMPSON, Mining Engineers

MINING ACTIVITY AT SOLEDAD MOUNTAIN AND MIDDLE BUTTES—MOJAVE MINING DISTRICT, KERN COUNTY [a] [b]

By W. B. TUCKER, District Mining Engineer

The Mojave mining district is situated in a group of small hills centering around Soledad Butte. These are located 4 to 6 miles southwest of Mojave, the junction of the Santa Fe and Southern Pacific railroads, and include the territory in T. 10 and 11 N., R. 11, 12 and 13 W., S. B. B. M. The Middle Buttes, a group of flat-topped hills, are situated 4 miles west of Soledad Mountain and 10 miles southwest of Mojave, in T. 10 N., R. 13 W.

History.

In 1894, gold was first discovered in the Mojave mining district which led to the development of the following productive mines: Queen Esther, Exposed Treasure, Karma, Elephant, Echo and Gray Eagle, and the Exposed Treasure was operated until 1914, when operations were suspended, and the district was dormant until 1922.

There was a revival of interest in the district in 1922, due to the discovery of high-grade gold ore in a small butte north of the Exposed Treasure Mine, which is on Bowers Hill. In June, 1922, the Yellow Dog Mining Company was organized for the development of the property, but the mine did not develop to expectations and the mining revival gradually died out.

Due to the depression and hard times from 1931 to 1934, there were fifty to seventy leasers working on the old mines in the district. The ore extracted by the leasers was hauled 17 miles to the Tropico mines where it was treated in the Tropico Mining & Milling Company's 50-ton cyanide plant operated by Clifford Burton. Mr. Burton secured a lease on the Exposed Treasure Mine and subleased the property to groups of leasers. In order to encourage leasing in the district, he furnished the leasers with mining equipment and arranged to haul the leasers' ore to his mill for treatment. Therefore, prospecting for ore and leasing was active during the period of depression.

The production of gold and silver from the district during this period amounted to $180,000.

On September 17, 1933, George Holmes, who was prospecting on Soledad Mountain with the idea of locating some ground to lease, discovered some high-grade float on the northwest slope of the mountain on a claim formerly known as the McBrayer. The claim is located just west of the Queen Esther Mining and Milling Company's patented claims.

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[a] Presented at fall meeting of American Institute of Mining and Metallurgical Engineers, at San Francisco, October 3, 1935.

[b] See also: State Mineralogist's Report XXX, pp. 315–317, 397–399, October, 1934.

After the discovery of this rich float, Holmes checked over the records at the recorder's office at Bakersfield and found that the claim was open for location, due to the fact that the former owners had failed to file their intention to hold the claim. George Holmes and associates located the claim as the Silver Queen, which comprised 18 acres. Then an intensive search for the vein was made by means of trenching and prospect shafts which resulted in finding the vein in place. Two shafts were sunk on the vein about 50 ft. apart and pay ore was found. They immediately started shipments to the smelter as, due to the high silver content, the Burton Bros. could not treat the ore. The property was worked by George Holmes and associates from September, 1933, to January, 1935, when they sold the mine to the Gold Fields American Development Company, a subsidiary of the Gold Fields of South Africa Mining Corporation.

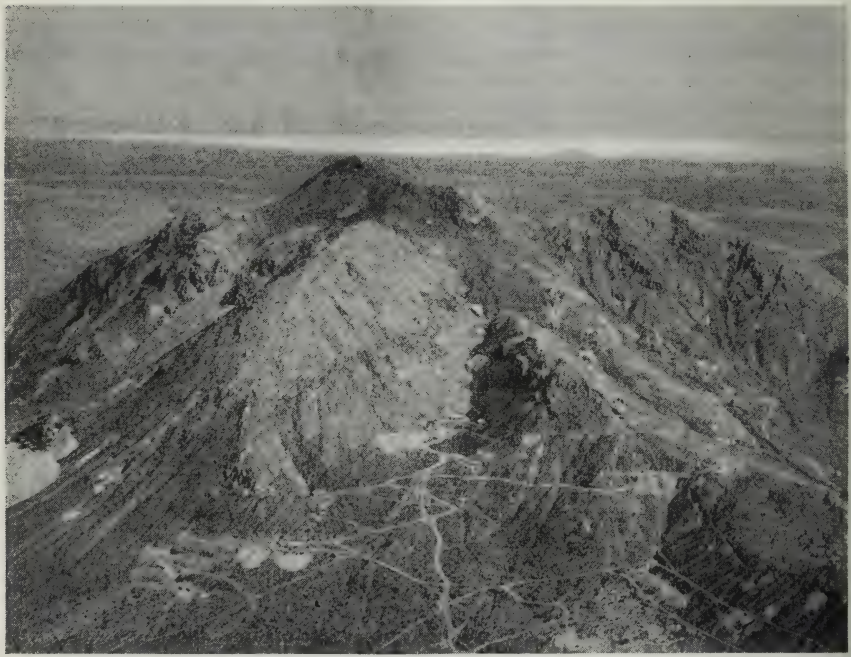

FIG. 1. Aerial view of Soledad Mountain, showing discovery point of Silver Queen vein (Golden Queen Company) at head of zigzag road at right of center. Queen Esther Mine dumps at extreme left.

Photo by Fairchild Serial Surveys, Inc., April 10, 1935.

During the period of operations before the sale of the property to this English mining corporation, the mine was developed by the owners to a depth of 400 ft. and the ore mined was shipped to the Selby smelter. The production from this development work amounted to $300,000.

The purchase of the property by this English mining corporation attracted the attention of mining companies and noted mining engineers

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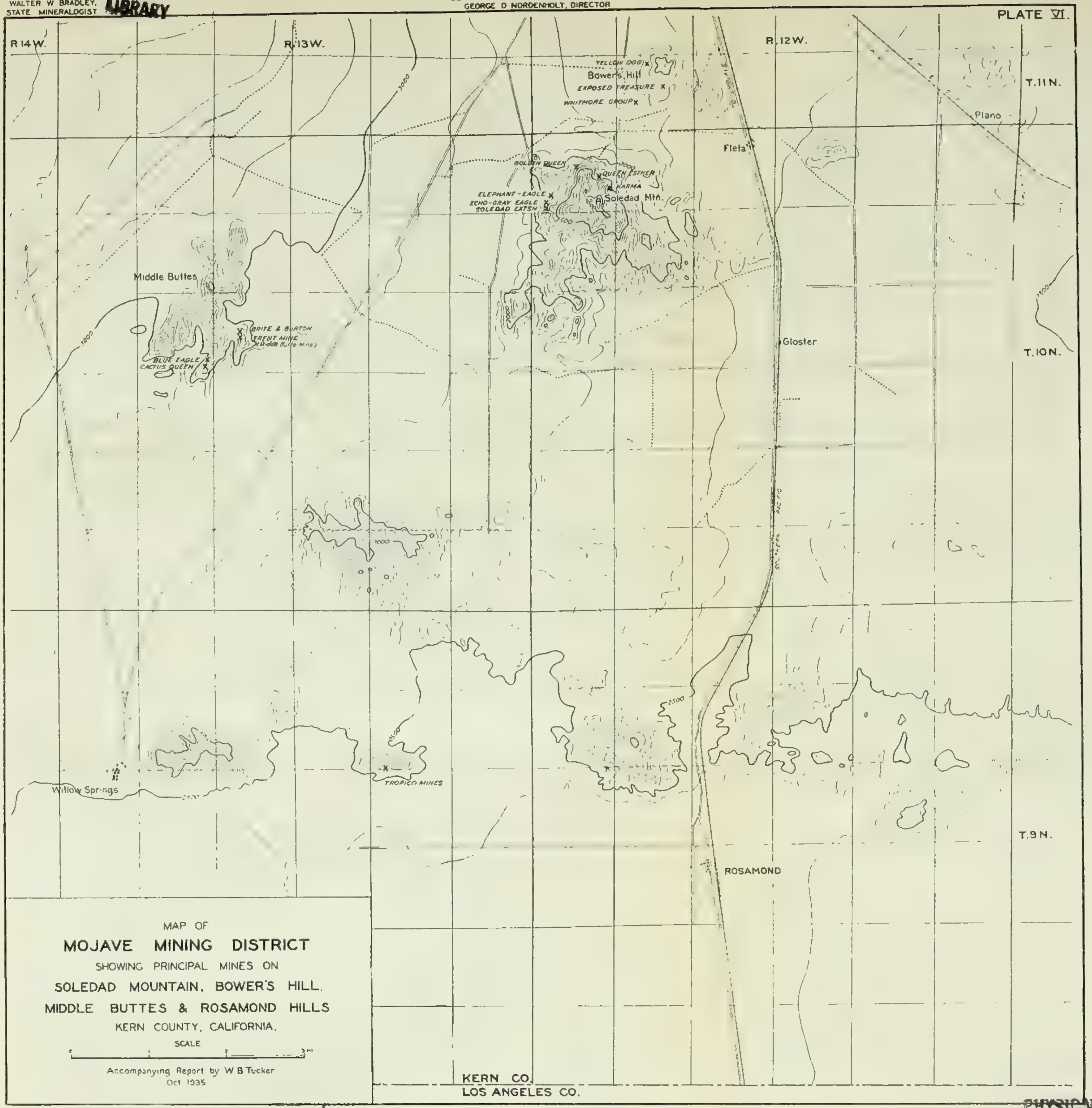
PLATE VI.


R.14W.
R.13W.
R.12W.
T.11N.
T.10N.
T.9N.
YELLOW DOG
Bower's Hill
EXPOSED TREASURE
WHITMORE GROUP
Plano
Flela
GOLDEN QUEEN
QUEEN ESTHER
KARMA
Soledad Mtn.
ELEPHANT-EAGLE
ECHO-GRAY EAGLE
SOLEDAD EXTSN
3000
3500
Middle Buttes
BRITE & BURTON
TRENT MINE
Middle Butte Mines
BLUE EAGLE
CACTUS QUEEN
Gloster
2500
TROPICO MINES
Willow Springs
ROSAMOND
KERN CO.
LOS ANGELES CO.

MAP OF
MOJAVE MINING DISTRICT
SHOWING PRINCIPAL MINES ON
SOLEDAD MOUNTAIN, BOWER'S HILL,
MIDDLE BUTTES & ROSAMOND HILLS
KERN COUNTY, CALIFORNIA.

SCALE

Accompanying Report by W B Tucker
Oct 1935

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of the United States to the Mojave mining district, resulting in the purchase of some of the old properties in the district, with a large amount of new development being prosecuted on the various mining claims on Soledad Mountain and on Bowers Hill. The active development of the mines on Soledad Mountain caused considerable prospecting to be done on the other buttes in the immediate vicinity.

In January, 1934, T. H. Brite and Clifford Burton discovered some high-grade float on the NW¼ of the NW¼ of Sec. 16, T. 10 N., R. 13 W., on the east slope of Middle Buttes. The quartz found showed gold and some of the quartz was stated to assay from $100 to $200 per ton. This discovery was on patented land and Brite and Burton secured a lease and bond on the property.

Active development was immediately started to find the vein, which was not definitely located until August, 1935. The vein quartz was rich in gold, visible to the eye.

Following the discovery of high-grade float by T. H. Brite on Middle Buttes, Walter E. Trent, of Tonopah, Nevada, acquired the SW¼ of the SW¼ of Sec. 16, T. 10 N., R. 13 W., and on March 1, 1934, Clyde Garrett uncovered the vein in place there. Samples taken from the outcrop assayed from $30 to $200 per ton in gold. A number of trenches were made to determine the course of the vein and its width. Later an open cut was made on the vein for a length of 150 ft. which has since been mined to a depth of 80 ft. The width of the vein developed was from 4 to 12 ft. The average grade of the ore shipped from this open cut is stated to be $70 per ton.

The total production to date is reported to be in excess of $150,000.

On the southwest slope of Middle Buttes two other mines have been developed known as the Cactus Queen and Blue Eagle. The vein developed on these two properties is from 15 to 20 ft. wide, with values ranging from $7 to $20 per ton in gold and silver.

Topography.

The topography presents low ranges of hills and isolated peaks of igneous (in part, volcanic) origin which rise not more than 1500 to 2000 ft. above the level of the desert; the valleys, which are of much greater area than the hills, are typical waste-filled interior basins, characteristic of the desert. Soledad Mountain is about 4000 ft. above sea level and 1250 ft. above the general level of the desert. A number of smaller hills are grouped south and west of Soledad Mountain. Bowers Hill or Exposed Treasure Hill is about one-quarter of a mile northeast of Soledad Mountain and has an elevation of 400 ft. above the desert. Middle Buttes, a group of flat-topped hills, is 4 miles west of Soledad Mountain and has an elevation of 3000 ft. above sea level.

Geology.

The geology of the Elizabeth Lake Quadrangle is described in detail by Edward C. Simpson, in State Mineralogist's Report XXX (1934), which covers the area in the northern part of the Elizabeth Lake Quadrangle in which Soledad Mountain and Middle Buttes are located. Accompanying this report is a geologic map showing the distribution of the rock formations. The reader is referred to the October, 1934, issue of the CALIFORNIA JOURNAL OF MINES AND GEOLOGY for a detailed description of the geology of the region. The writer will give herein only a brief outline of the economic geology, with a general description of the mines under active development since the publication of the July-October, 1933, issue of the CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

The Rosamond formation, made up of a series of tuffs, sandstones, conglomerates, volcanic flows of dacite and rhyolite, covers the entire area north of Rosamond hills and are the principal rock exposures on Soledad Mountain and Middle Buttes. Granite underlies the entire Mojave mining district. There is an exposure on the surface along the northeast flank of Bowers Hill which extends to the southwest. Dacite and rhyolite lie upon and in contact with the granite.

Vein System and Orebodies.

The gold and silver occur in a series of north and northwest trending quartz veins that traverse dacite flows and plugs. The veins occupy fault fissures of moderate displacement, usually from 10 to 50 ft. There does not seem to be any displacement since the veins were formed. The veins measure from 5 to 35 ft. wide. Considerable silver is associated with the gold and in some ore-shoots constitute the main value. The silver occurs as cerargyrite (horn silver) very finely disseminated through the quartz above the water level, changing in depth to argentite. The only exception is found on Middle Buttes on the Trent and Burton mines where the values are principally gold, with very low silver values. On the southwest slope of Middle Buttes, on the Blue Eagle and Cactus Queen mines, silver constitutes the main value in the veins on these two properties. The principal quartz veins are on the northern flank of Soledad Mountain, on Bowers Hill, west of Bowers Hill on the desert plain and on Middle Buttes.

The veins that have been worked to any extent on the northern flank of Soledad Mountain occur in dacite and are more or less parallel, their strike being N. 20° W. to N. 40° W. and dip 50° to 80° E. for a certain depth where they flatten rather abruptly. The exception to the rule in the dip of the veins is found on the Soledad Extension and Starlight veins which dip 53° to 70° to the west. The maximum width of the veins is about 35 ft., with a minimum width of 3 ft. The average width is about 14 ft.

Beginning at the west, the principal and largest veins are the Soledad Extension, Hope, Elephant, Starlight, Echo, Gray Eagle and Silver Queen, and about one-half mile farther east, Queen Esther, Karma and Double Standard veins. All of these veins are typical quartz veins, containing quartz and minerals derived from wall-rock and deposited in fissures. The pay ore is more or less irregularly distributed but it occurs in well-defined shoots or lenses, having a width of 4 to 35 ft., varying in size to 800 ft. along the veins.

On Bowers Hill there is a series of parallel veins which have a general north and south strike for a distance, then split into numerous branches in a northwesterly direction. The veins dip 60° E. for some distance, then flatten rather abruptly to inclinations, varying between 30° to 45°, growing flatter with depth as shown in lower workings of the Exposed Treasure mine. Here on the 900-ft. level, the dip of the

DIVISION OF MINES
WALTER W. BRADLEY,
STATE MINERALOGIST.

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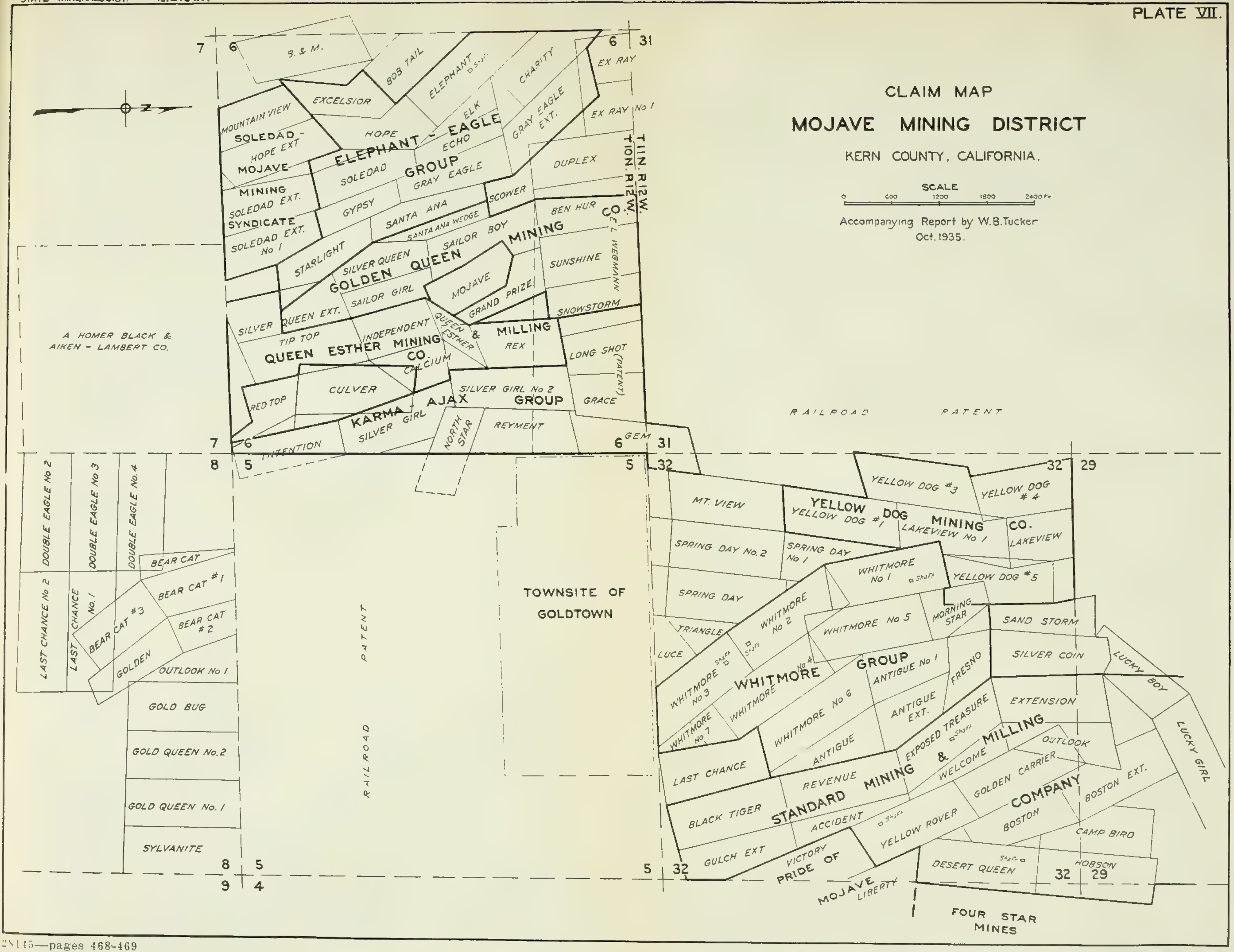
DEPARTMENT OF NATURAL RESOURCES,
GEORGE D. NORDENHOLT, DIRECTOR.

PLATE VII.



CLAIM MAP
MOJAVE MINING DISTRICT
KERN COUNTY, CALIFORNIA.

SCALE
0 600 1200 1800 2400 Ft

Accompanying Report by W. B. Tucker
Oct. 1935.

N
7
6
B. & M.
BOB TAIL
ELEPHANT
Shaft
CHARITY
EX RAY
EX RAY No 1
6
31
MOUNTAIN VIEW
EXCELSIOR
ELK
GRAY EAGLE EXT.
SOLEDAD - HOPE EXT
MOJAVE MINING SYNDICATE
HOPE
ELEPHANT - EAGLE GROUP
ECHO
DUPLEX
SOLEDAD
GRAY EAGLE
T.11N. R.12W.
T.10N. R.12W.
SOLEDAD EXT.
GYPSY
SANTA ANA
SCOWER
BEN HUR
SOLEDAD EXT. No 1
SANTA ANA WEDGE
SAILOR BOY
MINING CO.
E. L. WEGMANN
STARLIGHT
SILVER QUEEN
GOLDEN QUEEN
SUNSHINE
MOJAVE
SAILOR GIRL
GRAND PRIZE
SILVER
QUEEN EXT.
SNOWSTORM
TIP TOP
INDEPENDENT
QUEEN ESTHER
& MILLING
QUEEN ESTHER MINING CO.
REX
LONG SHOT (PATENT)
CALCIUM
A. HOMER BLACK & AIKEN - LAMBERT CO.
RED TOP
CULVER
SILVER GIRL No 2
AJAX GROUP
GRACE
KARMA
SILVER GIRL
NORTH STAR
REYMENT
GEM
7
6
INTENTION
6
31
RAILROAD PATENT
8
5
5
32
32
29
DOUBLE EAGLE No 2
DOUBLE EAGLE No 3
DOUBLE EAGLE No 4
BEAR CAT
BEAR CAT #1
LAST CHANCE No 2
LAST CHANCE No 1
BEAR CAT #3
BEAR CAT #2
GOLDEN
OUTLOOK No 1
GOLD BUG
GOLD QUEEN No. 2
GOLD QUEEN No. 1
SYLVANITE
RAILROAD PATENT
TOWNSITE OF GOLDTOWN
MT. VIEW
YELLOW DOG #3
YELLOW DOG #4
YELLOW DOG MINING CO.
YELLOW DOG #1
LAKEVIEW No 1
LAKEVIEW
SPRING DAY No. 2
SPRING DAY No 1
WHITMORE No 1
Shaft
YELLOW DOG #5
SPRING DAY
WHITMORE No 2
MORNING STAR
SAND STORM
TRIANGLE
WHITMORE No 5
LUCE
WHITMORE No 3
WHITMORE GROUP
No 4
ANTIGUE No 1
SILVER COIN
LUCKY BOY
WHITMORE
FRESNO
WHITMORE No 7
WHITMORE No 6
ANTIGUE EXT.
EXPOSED TREASURE
EXTENSION
ANTIGUE
LUCKY GIRL
LAST CHANCE
MILLING
OUTLOOK
REVENUE
MINING
WELCOME
GOLDEN CARRIER
BLACK TIGER
STANDARD
COMPANY
BOSTON EXT.
ACCIDENT
YELLOW ROVER
BOSTON
CAMP BIRD
GULCH EXT
VICTORY
PRIDE OF MOJAVE
LIBERTY
DESERT QUEEN
HOBSON
8
5
9
4
5
32
32
29
FOUR STAR MINES

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SCIENCES
LIBRARY

vein is only 25°. The wall-rock of these veins, for a distance, is dacite, and then the vein follows the contact between granite and dacite. The vein-filling of these lodes is quartz and calcite, with soft, black-brown mixture of ferruginous clay and manganese dioxide.

The pay ore is 4 to 15 ft. in width and lies in well-defined shoots or lenses varying in length to 400 ft. The gold occurs fine, associated with pyrite, chalcopyrite and smaller amounts of galena, marcasite and sphalerite. The silver occurs as cerargyrite (horn silver), changing to argentite in depth.

The Whitmore and Yellow Dog vein systems are west of Bowers Hill on the desert plain. The veins are more or less parallel and strike N. 30° W., dipping 45° to 60° E. Widths vary from 3 to 12 ft. The veins occur on contact of granite and dacite. The vein-filling is similar in character to the Exposed Treasure vein system, consisting of quartz with massive calcite and brownish-black ferruginous clay and manganese dioxide.

On Middle Buttes two vein systems have so far been developed; one on the southwest flank known as the Blue Eagle-Cactus Queen vein. This quartz vein traverses the dacite, is highly brecciated, and includes siliceous dacite. The vein strikes N. 45° E. and dips 35° SE. Widths of the vein vary from 7 to 25 ft. The vein occupies a fault fissure of moderate displacement. Considerable silver is associated with the gold and constitutes the main value. The silver occurs as cerargyrite (horn silver) very finely disseminated through the quartz, in depth changing to argentite. The other is on the east flank of Middle Buttes, known as the Trent or Middle Butte vein.

This vein occurs in fault fissure in silicified dacite, and shows moderate displacement. The vein strikes N. 26° W. and dips 35° E.; at a depth of 80 ft. flattens to 25°. The width of the vein varies from 6 to 15 ft. The vein quartz shows free gold, and ore mined and shipped to date shows only a small amount of silver. To the north of the Trent property on the Burton-Brite-Blank property, the extension of this vein has recently been discovered. The vein quartz shows free gold, with no silver values.

The approximate production of gold and silver from the Mojave mining district is $4,000,000 to $5,000,000. The present developments on the Golden Queen, Soledad Extension, Elephant-Eagle on Soledad Mountain, and the Middle Buttes mines assure an estimated production of $10,000,000 to $15,000,000 in gold and silver.

DESCRIPTION OF MINES

Blue Eagle Mine. It comprises 450 acres situated in S½ of Sec. 17, T. 10 N., R. 13 W., S. B. B. M., 7 miles southwest of Mojave and 12 miles northwest of Rosamond, on the southwest slope of Middle Buttes. Elevation 3000 ft. Owners, J. A. Otto and Fred L. Wright, Los Angeles. Under lease and bond to Kimball, Kemp and Pratt Syndicate, Ojai, California.

The country rock is dacite. The vein occurs as a fissure which may be the contact of two different flows. The Blue Eagle vein strikes N. 45° E., dips 35° E. Width of vein varies from 7 to 25 ft. The vein material is quartz with some inclosed wall-rock. The silver minerals contained in the vein quartz are cerargyrite and argentite which are finely disseminated in the quartz. The gold occurs associated with pyrite, arsenopyrite and marcasite. The value of the gold and silver is from $7 to $15 per ton. The vein can be traced on the surface for over 2000 ft. The Blue Eagle vein is intersected by three parallel veins which strike N. 70° E., dip 80° N. These veins have a width of 4 to 6 ft. The vein quartz is mineralized with pyrite, arsenopyrite and marcasite. The principal value is in silver, with low gold content.

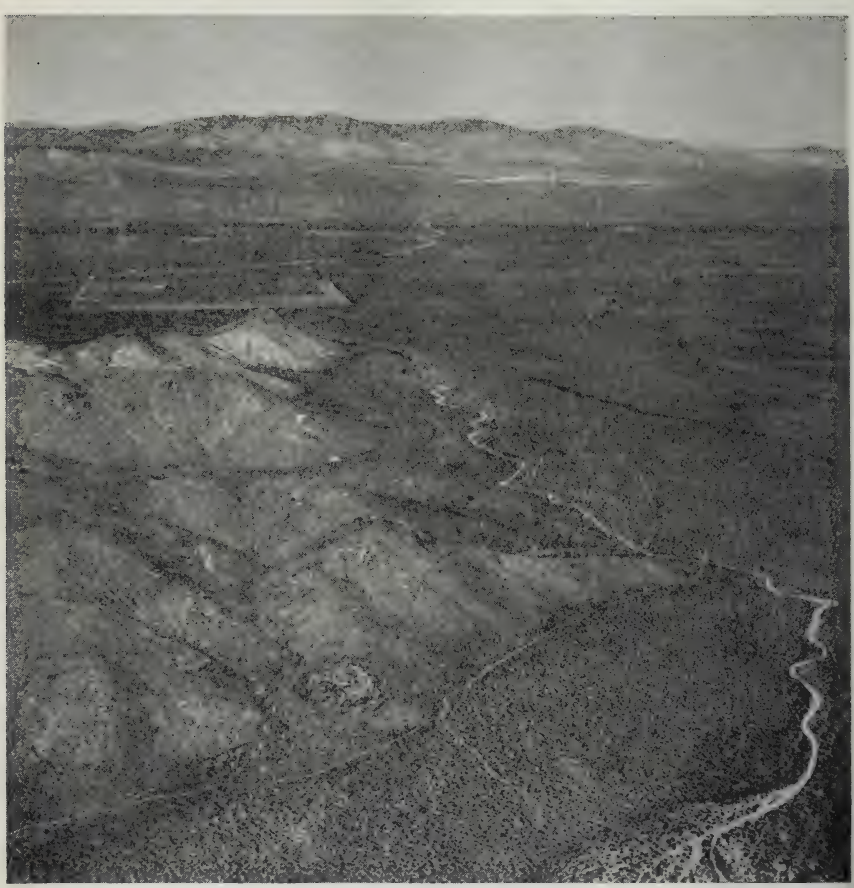

FIG. 2. Aerial view of east end of Middle Buttes, Kern County, looking north. Treat and Burton Mines are on ridge at left of center.

Photo by Fairchild Serial Surveys, Inc., April 10, 1935.

Development: A tunnel has been driven N. 45° E. on the vein a distance of 200 ft. At 112 ft. from the portal, a winze has been sunk on the vein to a depth of 52 ft. From the bottom of the winze there is a cross-cut driven southeast 60 ft. This cross-cut exposes the vein for a width of 22 ft. Samples cut across the vein are reported to show an average value of $7 per ton in gold and silver. Mine equipment consists of Rix compressor, driven by gasoline engine; cars and blacksmith shop. Six men are employed.

Burton-Brite and Blank Mine. It comprises 160 acres of patented land situated in the NE¼ of the NE¼ of Sec. 16, T. 10 N., R. 13 W., S. B. B. M., 10 miles southwest of Mojave and 12 miles northwest of Rosamond, on the east slope of Middle Buttes. Elevation 3000 ft. Owners, Clifford Burton, T. H. Brite and Ernest Blank, of Rosamond.

The formation is dacite thoroughly impregnated with silica. Near the crest of the hill there is a slide that evidently carried the surface outcrop of the vein down the east slope of the hill, as for a distance of 300 to 400 ft. in a north and south direction some very high-grade float quartz was found, showing visible gold. The gold in the quartz is associated with oxides of iron and manganese. The float picked up on the surface is reported to have assayed from $50 to $2000 per ton in gold.

The quartz recovered from surface is stated to have produced $10,000 in gold. After the discovery of this high-grade float an intensive search was made to find the vein in place. On August 15, what appears to be the vein in place was found about 700 ft. north of the end line of the Middle Butte Mine. The vein strikes N. 26° W.; dip 40° E.; width 4 to 6 ft. Quartz is rich in free gold. Previous to this discovery of the vein the following development work was done in the attempt to find the vein:

About 308 ft. in elevation below the top of the ridge, a tunnel was driven southwest into the hill a distance of 400 ft. The entire distance is in slide material. There is another tunnel at a higher elevation or 139 ft. below the collar of a shaft which is located on the crest of the ridge. This tunnel is driven southwest 165 ft. in slide material and so far no solid formation has been encountered. About 50 ft. north of the end line of the Middle Butte Mining Company's property, a shaft has been sunk vertically to a depth of 60 ft. At depth of 40 ft. the shaft cut through the vein that has been developed to the south on the Middle Butte Mine. A drift has been driven south on 60 ft. level connecting with the workings from open-cut on the property of the Middle Butte Mining Company. The vein was found to be very much broken, showing considerable displacement to the east.

Some very high-grade ore was encountered in these works but values were found to be irregular and spotty. Thus far, no continuous ore-shoot has been developed in the workings from this shaft.

Mine equipment consists of C. P. portable compressor; 15-h.p. gasoline-driven hoist; air drills and loading bins.

Ten men are employed on development work. T. H. Brite, superintendent.

Cactus Queen Mine. It comprises 31 acres situated in the S½ of Sec. 17, T. 10 N., R. 13 W., S. B. B. M., on the southwest slope of Middle Buttes, located on the same vein as is developed on the Blue Eagle Mine and adjoins this property on the southwest. The property is 10 miles southwest of Mojave and 12 miles northwest of Rosamond, a station on the Southern Pacific Railroad.

A quartz vein carrying values in gold and silver occurs in dacite. The strike of the vein is N. 45° E., dip 35° SE. Width of vein is 16 ft. Vein quartz is mineralized with free gold in very fine state. Silver occurs in the form of cerargyrite, finely disseminated through the quartz.

Development: A 2-compartment vertical shaft has been sunk to a depth of 100 ft., located 350 ft. southwest of Blue Eagle tunnel. At a depth of 45 ft. the shaft passed through the vein which had a thickness of 7 ft. On the 100-ft. level, a cross-cut is driven southeast to the vein, a distance of 27 ft., with drifts run southwest 200 ft. on the vein. The vein crosscut on this level had a thickness of 16 ft. A winze is being sunk on the footwall of the vein; present depth 40 ft. Ore extracted from development work on the 100 ft. level is hauled to Tropico Mining and Milling Company's mill for treatment. Ore milled is stated to have an average value of $18 per ton in gold and silver.

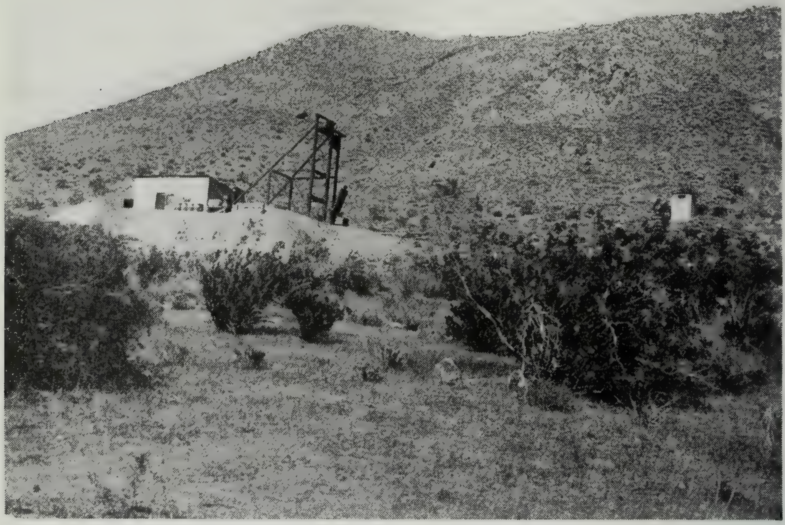

FIG. 3. Head frame and shaft, Cactus Queen Mine, Middle Buttes, Mojave Mining District, Kern County.

Mine equipment consists of compressor; 15-h.p. gasoline-driven hoist; air drills; blacksmith shop; 25-ton ore bins.

Owner, Clifford Burton, Rosamond, California. Under lease and bond to Cactus Mines Company; Maj. L. W. Wicks, president and general manager, 1200 Pacific Mutual Bldg., Los Angeles.

Ten men are employed on development work.

Elephant-Eagle Mines. It comprises the Elephant group of mines, totaling 100 acres, owned by Jessie Knight, of Mojave, California, and the Echo, Gray Eagle and Starlight mines, comprising 160 acres, of which 60 acres are patented. Recently purchased by John M. Rogers and associates, of New York City; John M. Rogers, manager; Albert Albertoli, superintendent, Mohave. Mr. Rogers has also exercised his option on the Echo-Gray Eagle and Starlight mines which will be operated under the same management with the Elephant-Eagle.

The Elephant-Eagle Mines are operated at present under a system of leases, there being 60 leasers working on the property. The ore extracted by leasers is milled in Elephant mill which has a capacity of 60 tons per 24 hours. The manager of the mine and mill is Louis Penhoel, of Los Angeles.

The above-mentioned properties are located on the northwest slope of Soledad Mountain, in Sec. 6, T. 10 N., R. 12 W., S. B. M., 4 miles south of Mojave. Elevation 3000 to 3500 ft.

On the Elephant group of mines, there are three roughly parallel veins known as the Hope, Excelsior and Elephant which occur in silicified dacite. The vein material is highly brecciated, containing quartz and including silicified dacite which is stained with iron oxide. The veins vary in width of 4 to 7 ft. These veins have a general northwest strike, with dips varying from 50° to 80° to the northeast. Ore-shoots in vein occur as irregular lenses which have a length of 100 ft. to 400 ft.

Echo-Gray Eagle vein system: There are three parallel veins, known as the Echo, Starlight and Gray Eagle which occur in dacite. The general course of these veins is northwest and with the exception of the Starlight which dips 70° W., they dip northeast. The veins vary in width from 4 to 7 ft. Gold occurs free, associated with pyrite. The silver occurs as cerargyrite (horn silver), 60% of which is gold and 40%, silver.

Since State Mineralogist's Report XXIX (on page 300 of which is a description of this property) was issued, the following development work has been done on the property: The Elephant shaft has been sunk to a depth of 500 ft., with 500 to 600 ft. of drifting on the 400-ft. level. The vein quartz on lower levels shows gold associated with pyrite, with silver in the form of argentite.

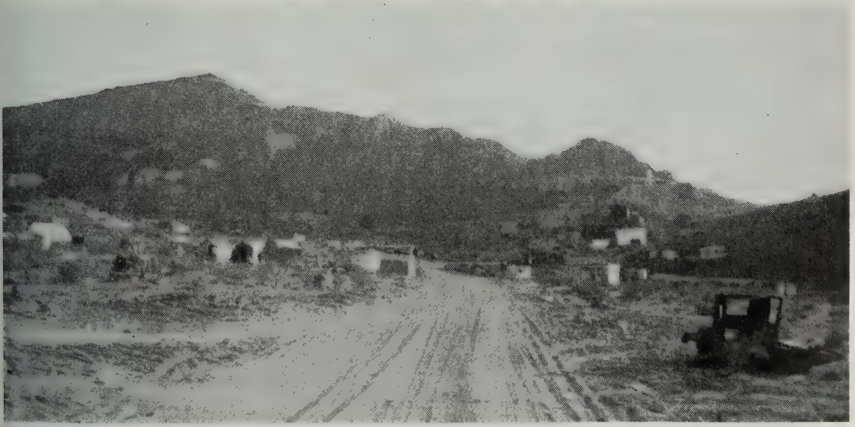

FIG. 4. Elephant-Eagle Mine (right) on west side of Soledad Mountain, near Mojave, Kern County.

Photo by Walter W. Bradley.

Mill: Ore from mine delivered to 50-ton ore bin. Ore passed over one-inch grizzly; oversize from grizzly to Gates D. gyratory crusher; crushed to pass $\frac{3}{4}''$ ring; from crusher elevated by bucket elevator to 50-ton fine ore bin; from ore bin fed by Gates feeders to belt feeder to 4 ft. by. 8 ft. Marathon rod mill which is in closed circuit with Dorr duplex classifier. Discharge from rod mill goes to amalgamation trap, with 5 lb. of mercury in bottom of trap. The trap is lined with amalgamation plates. Overflow from trap to launder lined with English corduroy cloth, to classifier. The pulp is ground in cyanide solution to 48-mesh; 2 lb. of cyanide per ton of solution; overflow from Dorr classifier to 2 launders 6 ft. in length by 8 inches wide, lined with English corduroy cloth; combined product from Dorr classifier through launders to 2 drag classifiers, 16 ft. in length by 2 ft. in depth; overflow from No. 1 drag classified to No. 2 drag classifier. The drag classifiers separate sand from slimes. Slimes flow to three 8 ft. by 12 ft. agitators, then pulp from agitators to 30 ft. by 8 ft. Dorr settling tank; then to two 4 ft. by 8 ft. agitators; then to 30 ft. by 12 ft. solution tank. Pregnant solution pumped to gold solution tank in mill, made up of 3-compartments with burlap filtering cloth. Pregnant solution flows to 3 sets of 6-compartment zinc boxes. Contact with solution takes 72 hours. Sands from drag classifiers to four 8 ft. by 12 ft. circular sand vats and then to four 30 ft. long by 16 ft. wide by 8 ft. deep sand vats. Solution from sand vats to solution tank, from which it is pumped back to gold solution tank in mill, then to zinc boxes. Slimes dewatered with Oliver filter. English gold-cloth concentrate cleaned up each 8-hr. run. Concentrates go to amalgamation barrel and tails from amalgation barrel returned to rod mill. Plant has a capacity of 50 tons per 24 hours.

Twenty men employed on company time in addition to 50 leasers operating on the property. These mines are reported to have a production of $400,000.

Bibl: State Mineralogist's Reports XIX, pp. 158, 159; XXV, pp. 31–33; XXIX, pp. 298–300.

Exposed Treasure and Desert Queen Mines. This property comprises 100 acres of patented ground and 60 acres held by location, located in Sec. 32, T. 11 N., R. 12 W., S. B. M., 3½ miles south of Mojave on Bowers hill. Owner, Gordon Gray, Bank of America Bldg., San Diego, California. A. J. Bruce, superintendent.

Seven parallel veins have been developed on the property. The principal development work has been on the Exposed Treasure and Desert Queen veins. These veins have a general north and south strike for a certain distance but split in numerous branches which strike northwest. The veins near the surface dip 60° northeast but with depth flatten to 30°. The veins have widths varying from 4 to 15 ft.

Present development is confined to the Desert Queen and Exposed Treasure workings where ore is being extracted and milled in 20-ton amalgation and flotation plant. Production record to date is over $2,000,000. Six to eight men are employed.

Bibl: State Mineralogist's Reports, XIX, pp. 160–161; XIV, pp. 493, 504–505; XXV, pp. 33–34; XXIX, pp. 301, 302.

Four Star Mines Group is 4½ miles south of Mojave in Sec. 33, T. 11 N., R. 12 W., adjoining the Desert Queen on the east. It comprises 28 acres, leased from C. C. Calkins by Tom Griffith and Ivar

Olson and transferred to Four Star Mines (a partnership), Lloyd Wright, 111 West 7 St., Los Angeles.

The property is on a flat between Bowers hill and the highway. A vertical shaft has been sunk to a depth of 250 ft. The first 50 ft. is decomposed granite; then a few feet of calcite and clay gouge, carrying pyrite, whence the shaft passed into a highly siliceous dacite. It is proposed to sink to 500 ft. and then cross-cut east and west.

Equipment consists of 60-h.p. diesel engine; 14 inch by 10 inch Clayton air compressor and hoist. Fifteen are employed on 3 shifts, sinking the shaft.

Golden Queen Mine (*Silver Queen*). The property comprises approximately 200 acres, situated on the northwest slope of Soledad Mountain, in Sec. 6, T. 10 N., R. 12 W., S. B. B. M., 4 miles south of Mojave, in the Mojave mining district. Elevation 3100 to 3800 ft.

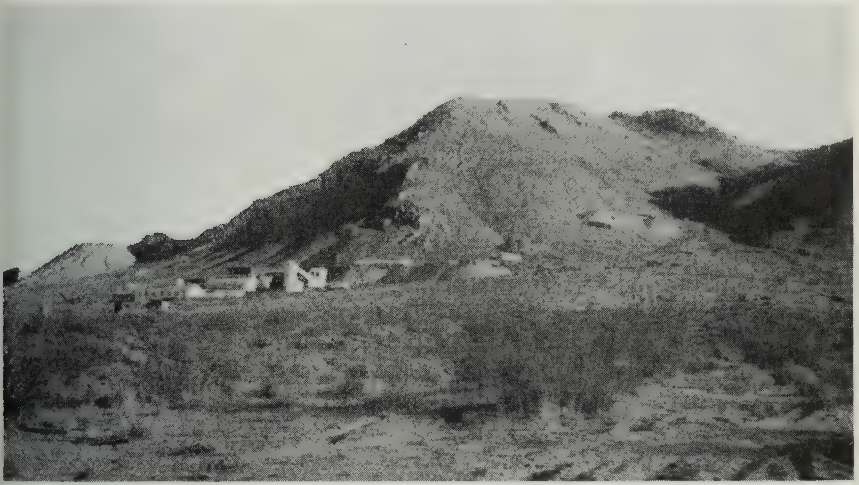

FIG. 5. Soledad Mountain and surface plant of Golden Queen Mining Co., near Mojave, Kern County. Old tailings dump of Queen Esther Mine at left.

Photo by Walter W. Bradley, October 23, 1935.

Owner, Golden Queen Mining Co.; H. S. Enlow, president; Peter Colfax, secretary; William C. Browning, manager and consulting engineer; J. H. Watson, general superintendent; Charles Kumpke, mine superintendent. Main office, 233 Broadway, New York City. Local office, 1214 Pacific Mutual Bldg., Los Angeles.

Since the purchase of the Silver Queen and Sailor Boy claims the company has acquired 6 additional claims and 40 acres of patented land on which are located the mill, offices and houses for company staff and employees. The acquiring of the additional mining claims gives 5000 ft. on the Silver Queen lode.

The Silver Queen vein occupies a fault fissure which traverses the dacite and appears to be the major fissure on Soledad Mountain, as the vein shows a greater width than the Queen Esther vein and also the ore-shoots are more continuous. The vein strikes N. 40° W., dips 55° northeast. The width of the vein varies from 7 to 40 ft., showing an average width of 25 ft. The ore-shoots are irregular lenses in the vein but the Silver Queen ore-shoot is more continuous than other ore-shoots developed in the district. The ore-shoot developed on the 200-ft. level is 900 ft. in length and will average 25 ft. in width. This ore-shoot has also been developed on the 400-ft. and 600-ft. levels and shows about the same average width as exposed on the 200-ft. level.

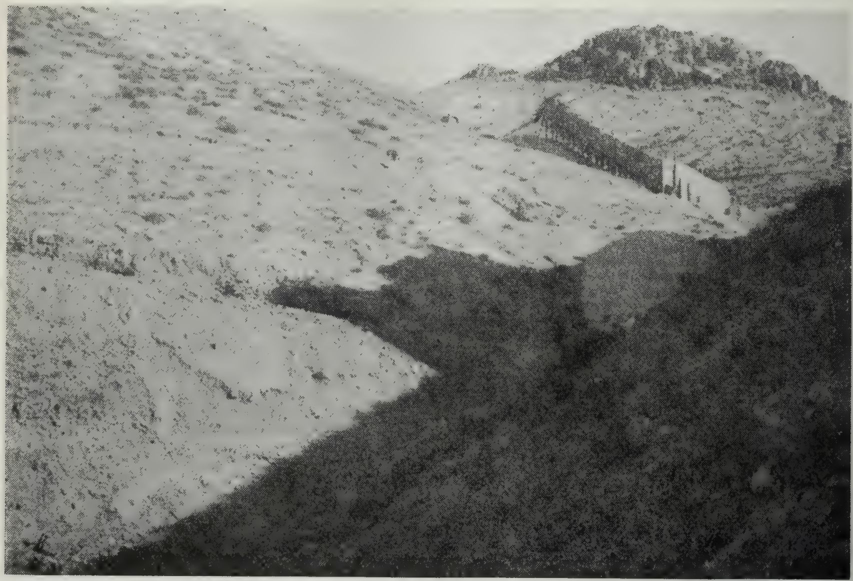

FIG. 6. Discovery point (at head of chute) on Silver Queen vein (Golden Queen Company) on Soledad Mountain.

Photo by Walter W. Bradley.

In this development along the Silver Queen vein five distinct flows have been recognized. There is a fault that strikes east and west which appears to be the same fault that displaced the Starlight vein and it passes southeast of the southeast shaft, or Emeric shaft, and shows considerable displacement of the vein on the 200, 400 and 600-ft. levels. The displacement is to the northeast. The vein material is highly brecciated, containing quartz and including silicified dacite which is stained with iron oxide. The gold occurs free, associated with pyrite. The silver occurs as horn silver (cerargyrite) changing to argentite in depth. The average value of the ore is reported to be $15 per ton, 60% of which is gold with 40% in silver.

Development: At an elevation of 3800 ft., two incline shafts about 45 ft. apart were sunk on the vein by the original owners to the 200-ft. level. On the 100-ft. level about 700 ft. of drifting has been done on the vein. On the 200-ft. level, a cross-cut tunnel has been driven south 140 ft. to the vein, with a drift southeast following the hanging wall of the vein for a distance of 800 ft., with a drift northwest 200 ft. on the vein from Kenneth Holmes winze which is located at the point where cross-cut tnnnel intersected vein. The Kenneth Holmes winze has been enlarged, size 4 ft. by 8 ft, and sunk on an incline of 55° to

600-ft. level for use as supply winze to transport men and equipment to upper levels when mine operations are started. :Two ore passes about 600 ft apart have been completed from the 200-ft. level to the 600-ft. level (main haulage tunnel). On the 200-ft. level raises have been put up at 25-ft. intervals, with shoots installed. The shrinkage method of mining the ore is planned.

At an elevation of 200 ft. below the 200-ft. level, the 400-ft. level is driven S. 40° E., 600 ft. to the foot-wall of the vein, connecting with supply winze at 700 ft. from the portal and drift is extended 500 ft. southeast in the foot-wall of the vein. The vein on this level has a width of 25 ft.

At an elevation of 3100 ft. the 600-ft. level, or main haulage tunnel, size 9 ft. by 8 ft., is driven southeast about 2200 ft. At 1500 ft. from portal it cut the orebody and at this point intersected the supply winze. The orebody developed on this level shows a width of 25 ft., and has been developed for a length of 100 ft. It is reported to average $9 per ton. On the 600-ft. level, the vein flattens to 42°.

The main haulage tunnel is equipped with 30-lb. steel rails. Ore will be transported from this tunnel by Westinghouse Electric locomotives to mill bins. The trains will be made up of 12 two-ton cars.

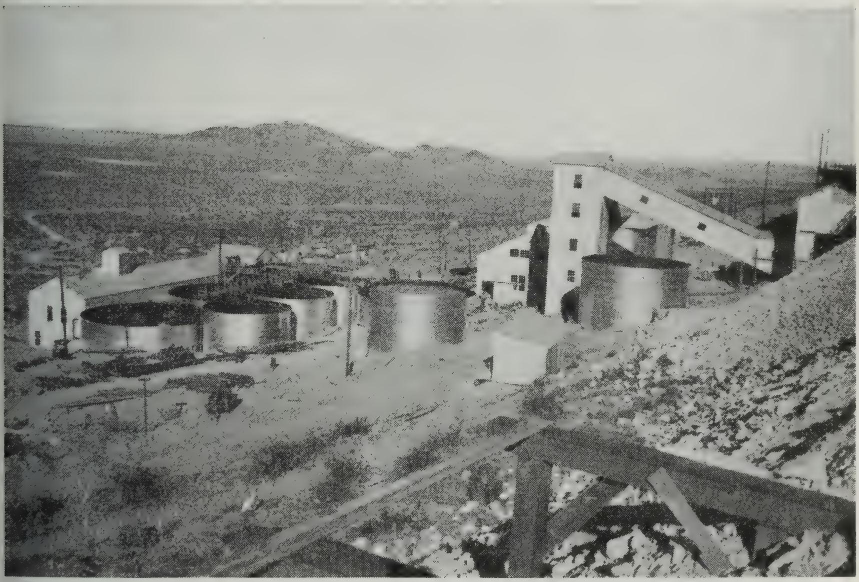

FIG. 7. New 300-ton mill and cyanide plant of Golden Queen Mining Company. Bowers Hill in distance.

Photo by Walter W. Bradley.

Mine equipment consists of 3 Imperial-type of Ingersoll-Rand compressors, 650 cu. ft., 750 cu. ft. and 850 cu. ft. capacity; complete machine shop and blacksmith shop.

*Golden Queen Cyanide Plant.** Capacity 350 tons per 24 hours. Electric haulage from mine to coarse-ore bins, with a total capacity of

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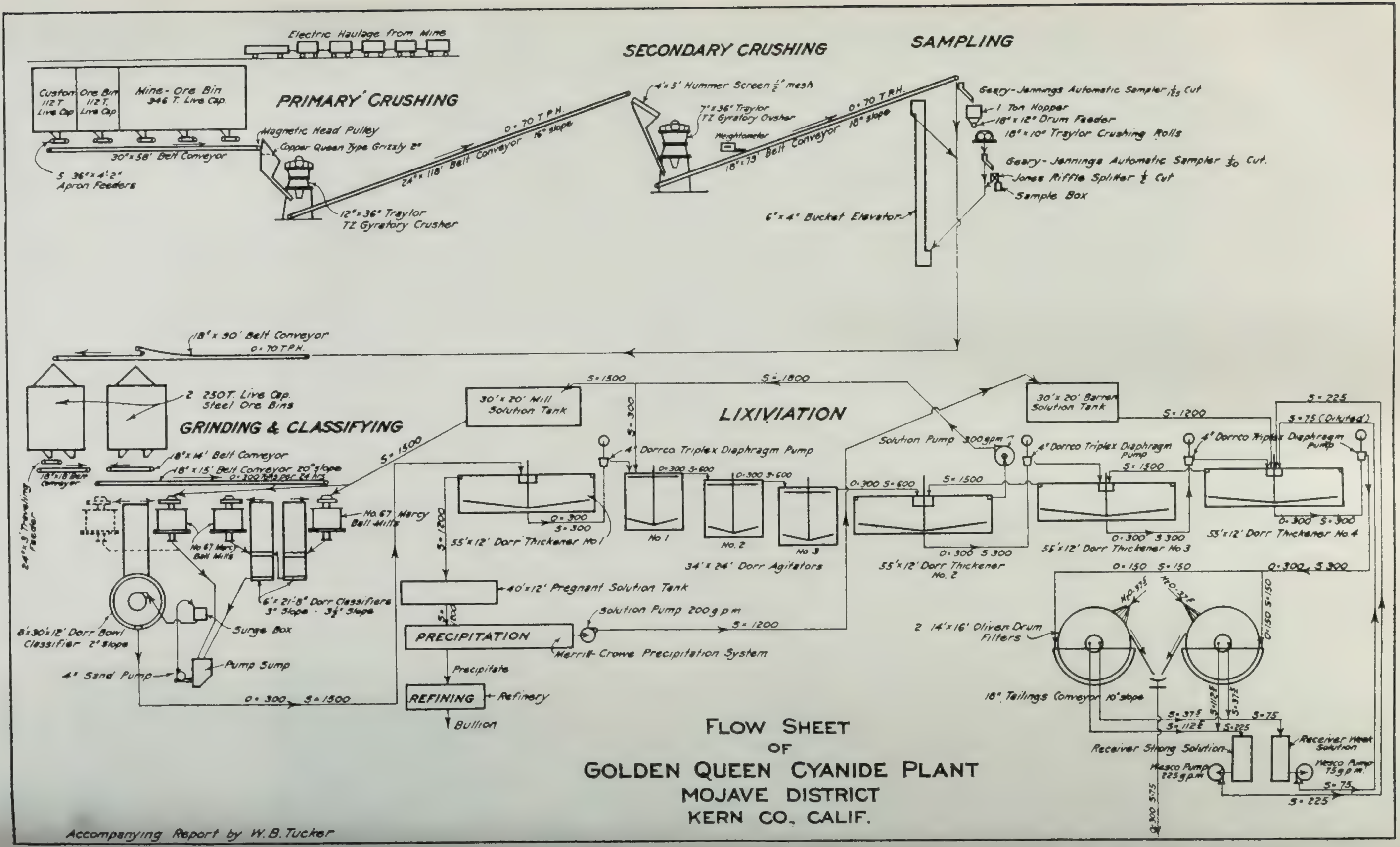
* Mill was put in operation late in October, 1935.


Electric Haulage from Mine
Custom 112 T. Live Cap.
Ore Bin 112 T. Live Cap.
Mine-Ore Bin 346 T. Live Cap.
5 36"x4'-2" Apron Feeders
30"x58' Belt Conveyor
PRIMARY CRUSHING
Magnetic Head Pulley
Copper Queen Type Grizzly 2"
12"x36" Traylor TZ Gyratory Crusher
24"x118' Belt Conveyor 16° slope
0-70 T.P.H.
SECONDARY CRUSHING
4'x5' Hummer Screen ½" mesh
7"x36" Traylor TZ Gyratory Crusher
Weightometer
18"x73' Belt Conveyor 18° slope
0-70 T.P.H.
SAMPLING
Geary-Jennings Automatic Sampler 1/25 Cut
1 Ton Hopper
18"x12" Drum Feeder
18"x10" Traylor Crushing Rolls
Geary-Jennings Automatic Sampler 1/10 Cut.
Jones Riffle Splitter ½ Cut
Sample Box
6"x4" Bucket Elevator
18"x90' Belt Conveyor
0-70 T.P.H.
2 250T. Live Cap. Steel Ore Bins
GRINDING & CLASSIFYING
18"x14' Belt Conveyor
18"x15' Belt Conveyor 20° slope
0-300 Tons per 24 hrs.
18"x18' Belt Conveyor
24"x3' Traveling Feeder
No. 67 Marcy Ball Mills
No 67 Marcy Ball Mills
6'x21'-8" Dorr Classifiers 3" Slope - 3½" Slope
8'x30'x12' Dorr Bowl Classifier 2" Slope
Surge Box
Pump Sump
4" Sand Pump
0-300 S-1500
S-1500
30'x20' Mill Solution Tank
S-1500
S-300
S-1800
LIXIVIATION
4" Dorrco Triplex Diaphragm Pump
55'x12' Dorr Thickener No 1
0-300 S-300
S-1800
0-300 S-600
No 1
No. 2
No 3
34'x24' Dorr Agitators
40'x12' Pregnant Solution Tank
S-1200
PRECIPITATION
Solution Pump 200 g.p.m.
S-1200
Merrill-Crowe Precipitation System
Precipitate
REFINING
Refinery
Bullion
0-300 S-600
S-1500
Solution Pump 300 gpm
4" Dorrco Triplex Diaphragm Pump
55'x12' Dorr Thickener No. 2
0-300 S-300
30'x20' Barren Solution Tank
S-1200
S-1500
55'x12' Dorr Thickener No 3
0-300 S-300
4" Dorrco Triplex Diaphragm Pump
55'x12' Dorr Thickener No. 4
0-300 S-300
S-225
S-75 (Diluted)
0-150 S-150
0-150 S-150
0-300 S-300
H₂O-37.5
H₂O-37.5
2 14'x16' Oliver Drum Filters
18" Tailings Conveyor 10° slope
S-37.5
S-112.5
S-112.5
S-37.5
S-225
S-75
Receiver Strong Solution
Receiver Weak Solution
Hesco Pump 225 g.p.m.
Hesco Pump 75 g.p.m.
S-75
S-225
0-300 S-75

FLOW SHEET
OF
GOLDEN QUEEN CYANIDE PLANT
MOJAVE DISTRICT
KERN CO., CALIF.

Accompanying Report by W. B. Tucker

700 tons, of which 200 tons is for custom ore. Ore from bins to five 36-in. by 4-ft. 2-in. apron feeders to 30-in. belt conveyor, equipped with magnetic head pulley; then to 2-in. grizzly; oversize from grizzly to 12-in. by 36-in. gyratory crusher; 2-in. size product to 24-in. inclined belt conveyor, to 4-ft. by 5-ft. Hummer screen, sized to ½-in; oversize to 7-in. by 36-in. gyratory crusher; crushed product to inclined 18-in. belt conveyor, equipped with weightometer and induction coil brake to Vezin-type sampler; riffle splitter to sample box. Reject from sampler to 18-in. belt conveyor where it is joined by reject from second sampler to 6-in. by 4-in. bucket elevator return. Belt conveyor discharges ore into two 250-ton crushed-ore bins, served by traveling feeders to 18-in. belt conveyors, which discharge ore on to 18-in. incline conveyor equipped with induction coil brake, to three No. 67 Marcy ball mills where ground to 85 per cent through 200-mesh.

Two of the Marcy mills are in closed circuit with duplex Dorr classifiers and the third Marcy mill in circuit with a Dorr bowl classifier. These ball mills are so arranged that the grinding may be accomplished in one, two or three stages. From the classifiers, the ground pulp goes to 55-ft. by 12-ft. Dorr thickener No. 1; solution overflow to 40-ft. by 12-ft. pregnant solution tank; the pulp from No. 1 thickener pumped by 4-in. Dorrco diaphragm pump to three 34-ft. by 24-ft. Dorr agitators; overflow from agitators goes to 55-ft. by 12-ft. Dorr thickener No. 2; solution from thickener No. 2 pumped by solution pump to 30-ft. by 20-ft. mill solution tank; pulp from No. 2 thickener pumped by 4-in. diaphragm pump to 55-ft. by 12-ft. Dorr thickener No. 3; pulp from No. 3 thickener pumped by 4-in. diaphragm pump to 55-ft. by 12-ft. Dorr thickener No. 4. Solution from No. 3 and No. 4 thickeners flows back to No. 2 thickener and joins overflow from No. 2 thickener and pumped by solution pump to mill solution tank. Pulp from No. 4 thickener is pumped by a 4-in. Dorrco triplex diaphragm pump to two 14-ft. Oliver filters; discharge from Oliver filters to 18-in. tailings belt conveyor. Solution from Oliver filters to solution tanks and then pumped back by Wesco pumps to No. 4 Dorr thickener. Solution from No. 1 Dorr thickener goes to Merrill-Crowe precipitation plant.

Two hundred men are employed, 50 men on development work in the mine and 150 on construction of mill and surface plants. Water will be secured from wells on the ranch near Actis service station, 4½ miles southeast of mine. On the flat below the mill there is a steel tank having a capacity of one-quarter million gallons of water. There is another steel tank at the 400-ft. tunnel level with a capacity of 100,000 gallons. The pipeline from wells to storage tank at mine consists of 2½ miles of 4-inch pipe and two miles of 2-inch pipe. Electric power is secured from the Southern Sierras Power Co. Recorded production to date is $300,000.

Karma Mine. It comprises 3 claims and 40 acres of patented land on the east slope of Soledad Mountain, located in Sec. 6, T. 10 N., R. 12 W., S. B. M., 4 miles south of Mojave. Owner, E. L. Wegmann, Mojave, California.

Two parallel veins occur on the property. The veins vary in width from 4 to 15 ft. The general course of the veins is N. 10° W., dip 60°

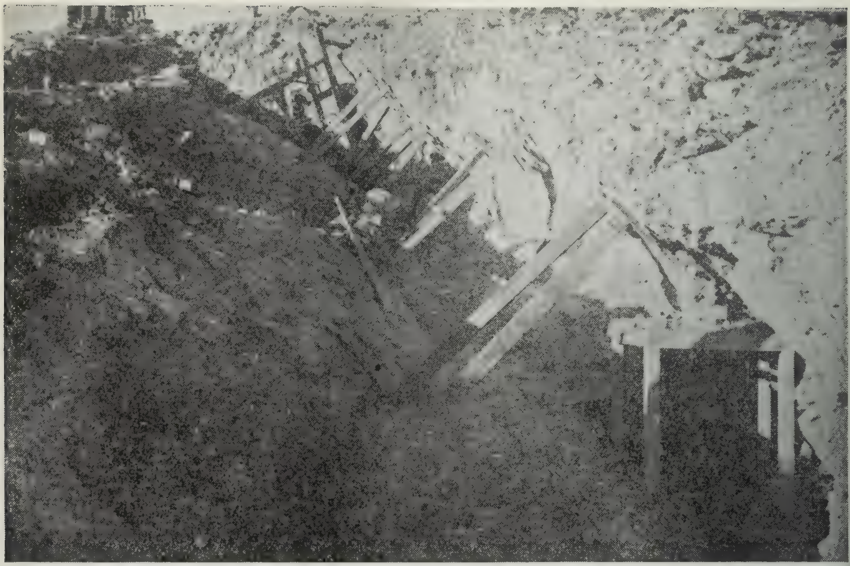


FIG. 8. Open-cut stope from surface, on 'Trent Lease,' Middle Butte Mine, on Middle Buttes near Mojave, Kern County. Over $150,000 taken from this stope in three weeks. Brite shaft at upper left. Looking north.

Photo by Walter W. Bradley.

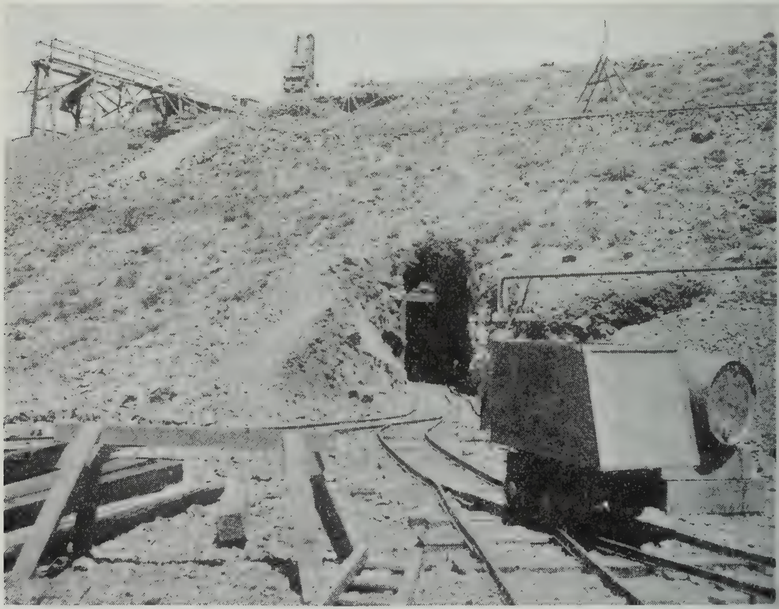


FIG. 9. Portal of Upper Tunnel, Middle Butte Mine ('Trent Lease'), Middle Buttes, Kern County. Open-cut, high-grade stope is in front of head frame at skyline.

E., with silicified dacite walls. Ore-shoot was 240 ft. in length; average width 15 ft. Idle.

Bibl: State Mineralogist's Reports XIV, p. 444; XIX, p. 161; XXV, p. 37; XXIX, p. 311.

Middle Butte Mine. It comprises 160 acres situated in the SW$\frac{1}{4}$ of the SW$\frac{1}{4}$ of Sec. 16, T. 10 N., R. 13 W., S. B. B. M., on the east slope of Middle Buttes, 10 miles southwest of Mojave and 12 miles northwest of Rosamond, a station on the Southern Pacific Railroad. Elevation 3000 ft. Under lease and bond to Walter E. Trent, Tonopah, Nevada. Mr. Trent has also acquired the Willow Springs Ranch, which is located 6 miles south of the mine. The water on this ranch is sufficient for mining and milling purposes. The mine management maintains offices and quarters at the ranch. Walter E. Trent, manager; Charles Wilkensen, consulting engineer; James Garnier, mine superintendent.

The vein occurs in silicified dacite and due to this silicification, also weathering action, shows no outcrop, which accounts for the difficulty of locating the vein. The course of the vein is N. 26° W.; dips 35° E.; width varies from 6 to 8 ft. However, the mineralization extends for a considerable distance into the wall-rock on both sides of the fissure, indicating that the width of commercial ore that can be mined will probably be about 15 to 20 ft. At an elevation 3000 ft. near the crest of the ridge an open-cut has been made along the vein for a distance of 150 ft. Width of ore mined from this cut is 6 to 8 ft. and it has been mined to a depth of 80 ft. The ore mined from this ore-shoot is said to have averaged $70 per ton in gold. Production to date has been in excess of $150,000. The vein material is highly brecciated quartz, heavily stained with iron oxide. The gold occurs free and finely disseminated through the quartz.

Development: On south slope of hill at an elevation of 80 ft. below surface outcrop of vein, a tunnel is driven N. 20° W. connecting with workings from open-cut. Length of tunnel is 350 ft. On the southeast slope of the hill and 150 ft. vertically below upper mine workings, a cross-cut tunnel is being driven west to intersect the vein. At the time the property was visited the tunnel was in 500 ft. They expect to intersect the vein at 800 ft. from portal. The portal of tunnel is 800 ft. east of upper workings. The formation passed through for a distance is tuff and then dacite.

Mine equipment consists of portable compressor, capacity 300 cu. ft.; air drills; blacksmith shop and 50-ton ore bins. The management is planning to install 150-ton cyanide plant at Willow Springs for treatment of the ore; at present shipping high-grade ore to the Selby smelter and lower grade ore is hauled to the Burton Bros. custom mill at Tropico.

Twenty-five men are employed.

Pride of Mojave Mine. It is situated in Sec. 32, T. 11 N., R. 12 W., S. B. B. M., 4 miles south of Mojave and adjoins the Exposed Treasure claims on the east. Elevation 2700 ft. Owner, C. C. Calkins, Mojave, California. Under lease to J. J. Murray.

The vein, which has a general north-south strike, varies from 3 to 7 ft. in width. Its dip is approximately 60° E. The foot-wall is granite, the hanging-wall is probably dacite, although nowhere well-exposed.

The vein filling is largely calcite, with occasionally a little quartz and some clay, stained with the oxides of iron and manganese.

Development consists of a shaft sunk 257 ft. on an inclination of 65°. At the 137 ft. level a drift has been driven north 150 ft. and south the same distance. At approximately 120 ft. north of the shaft, a raise has been put through to the surface.

The shaft followed the vein to approximately 100 ft., from which point it is in the foot-wall.

Equipment consists of 30-h.p. electric hoist; 12-inch by 10-inch air compressor, driven by 40-h.p. motor.

Ten men are employed sinking the shaft and drifting on the 137-ft. level.

Queen Esther Mine. It comprises 100 acres, situated in Sec. 6, T. 10 N., R. 12 W., S. B. B. M., on the east slope of Soledad Mountain, 4 miles south of Mojave. Elevation 3200 ft. Owner, Queen Esther Mining & Milling Co., 1206 Pacific Mutual Bldg., Los Angeles.

Formerly the largest producing mine in the district. Recorded production was $1,300,000.

Bibl: State Mineralogist's Reports XIV, p. 508; XIX, p. 162; XXV, p. 46.

Soledad Extension Mine. It comprises 4 claims, totaling 82 acres, situated on the southwest slope of Soledad Mountain, in Sec. 6, T. 10 N., R. 12 W., S. B. B. M., 12 miles south of Mojave. Elevation 3000 ft. Owners, Clifford Burton, Tropico, California, and Bert Fisher, Mojave, California. Under lease and bond to the Soledad Mojave Mining Syndicate; Walter E. Trent and associates, of Reno, Nevada.

There are two parallel veins that occur as a fault fissure near contact of rhyolite and rhyolitic porphyry. The veins are known as Soledad and Contact. Strike is N. 50° W., dip 53° W. Length proved on surface is 2000 ft. The vein material is highly brecciated quartz, stained with iron oxide. Gold occurs free, silver as cerargyrite, changing to argentite with depth. The width of the veins is 7 to 30 ft. Average width of vein is 15 ft.

Development consists of a tunnel 600 ft. in length driven southeast intersecting the vein at 300 ft. Two shoots of ore have been developed in this tunnel. First shoot was cut at 320 ft. southeast of portal. The ore-shoot is 120 ft. long, with an average width of 15 ft. Then 100 ft. of low-grade before encountering next ore-shoot which is 140 ft. in length. The face of the tunnel is in ore. The average grade of the ore developed is said to be $15 per ton in gold and silver.

Estimated tonnage of ore developed is 15,000 tons. About 75 ft. west of portal of tunnel, they are sinking a 2-compartment shaft on the vein, present depth of which is 200 ft., and expect to sink to a depth of 300 ft. before drifting.

Mine equipment consists of 12-inch by 10-inch Ingersoll-Rand compressor, driven by 50-h.p. motor; 30-h.p. electric hoist at winze; and 75-h.p. electric hoist at shaft. Electric power is secured from Southern Sierras Power Co. Twelve men are employed on development work.

Tropico Mine. Since the issuance of the July-October, 1933, number of the CALIFORNIA JOURNAL OF MINES AND GEOLOGY (State

Mineralogist's Report XXIX), the following important developments have been under way at this property:

On the 500-ft. level an ore-shoot was encountered at 500 ft. west of the shaft. On this level it has a length of 200 ft. and a width of 15 to 20 ft. Average values are reported to be in excess of $20 per ton in gold. It is believed that this is the downward extension of an ore-shoot mined from the 300-ft. level upward, which has been faulted. The fault makes an acute angle with the vein, resulting in a displacement of the ore-shoot downward and to the west, hence practically none of this ore was encountered on the 400-ft. level. At 600 ft. from the shaft a raise has been driven 175 ft. Average values are said to be $12 per ton. At 700 ft. from the shaft another raise is now up about 25 ft. and midway between the two raises a winze is down about 15 ft.

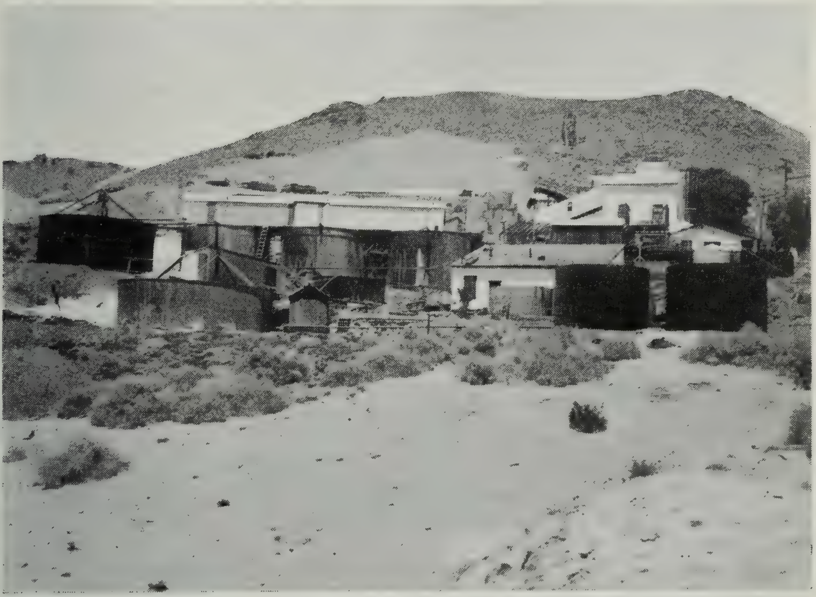


FIG. 10. Burton Bros. cyanide mill, capacity 50 tons, Tropico Mining & Milling Company, Rosamond, Kern County.

Both the new raise and the winze are reported to show values of from $50 to $80 per ton.

Operators are now cleaning out the shaft to the 700-ft. level, intending to tap the shoot at this horizon. At present 9 men are employed underground on one shift.

The mill on this property consists of the following:

There is on the ground and will be immediately installed a 12-inch by 22-inch jaw crusher, discharge to 14-inch belt conveyor to gyratory crusher (which is now in operation), 2-inch discharge to 14-inch belt conveyor, 50 ft. centers on a 22° incline, discharging to either of two 60-ton bins. This stream is intercepted by a chain sampler. Sample goes to sample room where it is crushed, split, ground and quartered for the assayer-reject by elevator back to bins.

Conveyor discharge may be sent either to bin feeding ten 1050-lb. stamps or to bin with reciprocating feeder to 4-ft. by 6-ft. Allis-Chalmers ball mill, driven through a flexible coupling by a 75-h.p. motor, in closed circuit with a drag classifier, overflow to stationary corduroy-cloth tables, tails to a drag classifier.

The stamp batteries are equipped with 8 and 10-mesh screens which discharge to Dorr-type simplex classifier in closed circuit with 4-ft by 4-ft. Marcy-type ball-mill, driven by 30-h.p. motor. Slimes from classifier to corduroy cloth, stationary table, tails to drag classifier mentioned above, overflow to 5 mechanical agitators ranging from 25 to 30 ft. in diameter to 40-ft. Dorr thickener. Solutions are sand-filtered before going to gold tank and 6 zinc boxes.

Sands are treated in 5 rectangular steel tanks 44 ft. long by 15 ft. wide, 5 ft. deep at one end and 10 ft. at the other. Now installing 4 diaphragm pumps to raise slimes from classifier to new 40-ft. Dorr thickener. Plant is treating 80 tons per day with 31 men employed.

Bibl: State Mineralogist's Reports XIV, p. 512; XXV, pp. 50–51; XXIX, p. 331.

The Fairview Claim of the Tropico Mine has been leased to H. Kelsey and Mrs. Jennie Kelsey, Rosamond, California. The lease includes 200 ft. of the east end of the Home No. 1 claim and has been in effect since May, 1933.

The vein is the easterly continuation of the Home vein, on which the main workings of the Tropico Mine are situated.

The present operator has done about 1000 ft. of work as follows:

150 ft. level, drifted 325 ft. W.; 240 ft. level, drifted 325 ft. W.; 300 ft. level, drifted 260 ft. W. and 109 ft. E. The shaft has been sunk 65 ft. to a depth of 365 ft. and is now sinking.

In 1934, 5500 tons were shipped to the Tropico mill and there are 11,000 tons broken in the stopes. A large part of this broken ore has been slabbed from the foot and hanging walls of old stopes, which have been widened to an average width of 10 ft., originally having been stoped 6 ft. in width.

The ore-shoot here is approximately 700 ft. long, having an average width of 7 ft. The vein having an E.-W. strike has been displaced by a NW.-SE. system of minor faults. Displacement varies from 3 to 10 ft. On the 300-ft. level the shoot apparently has been broken into short lenses, which may be wedges formed by faults, a similar condition having been encountered in the Tropico Mine. The average value of the ore as mined is between $10 and $11 per ton.

Equipment consists of 35-h.p. electric hoist; 12-inch by 10-inch Ingersoll-Rand air compressor, driven by 60-h.p. motor and No. 5 Ingersoll-Rand drill sharpener. Ore is hoisted in one-ton skip. Machine shop contains 16-inch lathe and 16-inch Cincinnati shaper. Seven men are employed, 6 of them underground.

Whitmore Mine. It comprises 10 claims totaling 100 acres, situated in Sec. 32, T. 11 N., R. 12 W., S. B. B. M., 3½ miles south of Mojave. Elevation 2700 ft. Owner, W. K. Whitmore and J. E. Whitmore, Mojave, California.

Four parallel veins occur along a series of roughly parallel rhyolitic-porphyry dikes. Veins strike N. 30° W., dip 60° E. Widths vary from 2 to 6 ft.

Bibl: State Mineralogist's Reports XIX, pp. 152–163; XXV, p. 52; XXIX, pp. 334–335.

Yellow Dog Mine. It comprises 8 claims, totaling approximately 160 acres, of which 29 acres are patented, located in Sec. 29, 32, T. 11 N., R. 12 W., S. B. B. M., 3 miles south of Mojave. Elevation 2700 ft. Owner, Yellow Dog Mining Co.; P. O. Paulson, president; Walter Kibby, secretary; Bert Fisher, vice president. Offices: 715 Hibernian Bldg., Los Angeles. Under lease to E. L. Wegmann, Mojave, California.

The vein strikes north and dips 60° to the east. Average width 6 ft. Ore is being milled in two-stamp mill. Six men are employed.

Bibl: State Mineralogist's Reports XIX, pp. 163–164; XXV, p. 55; XXIX, pp. 338–339.

GEOLOGIC BRANCH

CURRENT NOTES

By Olaf P. Jenkins, Chief Geologist

The older 'basement' rocks of an area in western Riverside County, 60 miles south of Los Angeles, are carefully described by Paul H. Dudley in his following contribution, 'Geology of a Portion of the Perris Block, Southern California.' Since it is the policy of the Division of Mines to coordinate the scientific point of view with the more economic, a supplementary report has also been prepared covering the same area but on the subject of 'Mineral Resources,' by R. J. Sampson. The accompanying map (which should be designated as Plate VIII) shows both the areal distribution of the geologic formations and the locations of the mines and prospects.

Since there has been such a constant demand for the new geologic map (now in preparation) of the State of California, it is found necessary that preliminary progress sheets must be issued. It is planned to publish these soon, and in advance of the final completed and colored map of the state.

The following manuscript has been received and will be published by the Division of Mines in an early issue of the Journal:

''The Discovery of Borates in California and the Minerals of Borax Lake, Lake County,'' by M. Vonsen and G. D. Hanna, California Academy of Sciences.

GEOLOGY OF A PORTION OF THE PERRIS BLOCK, SOUTHERN CALIFORNIA

By Paul H. Dudley*

OUTLINE OF REPORT

Page
ABSTRACT 487
INTRODUCTION 488
  Purpose and Scope 488
  Economic Significance 488
  Geographic Location 489
  Previous Investigations 490
  Acknowledgments 491
DESCRIPTIVE AND HISTORICAL GEOLOGY 491
  General Statement 491
  Elsinore Metamorphic Series 493
    Description of the Series 493
    Schists and Gneisses 493
    Slates 493
    Granulites 494
    Meta-volcanics 494
    Origin 495
    Structure 495
    Types of Metamorphism 495
    Evidence of Age 496
  Temescal Dacite-Porphyry 497
    Description 497
    Origin 497
    Intrusive Effects 497
    Effects of Other Igneous Intrusions 497
    Evidence of Age 499
    Correlation 499
  Virginia quartz-hypersthene norite 501
  Gabbro 501
  Perris quartz diorite 501
  Estelle quartz diorite 502
  Lakeview quartz-hornblende diorite 502
  Steele Valley granodiorite 502
  Cajalco quartz monzonite 502
SEQUENCE AND CORRELATION OF THE PLUTONIC ROCKS 503
ECONOMIC GEOLOGY 505

ABSTRACT

The area herein described constitutes an irregular central portion of the Elsinore quadrangle, and a part of the Corona quadrangle, Riverside County, southern California, and lies some 60 miles southeast of Los Angeles.

The mineral resources of the region are gold, tin, feldspar, quartz, magnesite, monumental stone and road material, all of which have been or are being mined. The determination of the areal geology and establishment of the sequence of the major rock types as presented in this paper should be of material assistance to future mining exploration and development.

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* Consulting Geologist, Long Beach, California.

The region is comprised mainly of crystalline rocks. The oldest of these is an extensive series of metamorphics which has been designated the Elsinore series. Injected into these meta-sediments and meta-volcanics is an unusual igneous rock body, herein named the Temescal dacite-porphyry. It represents an intrusion at intermediate depth and is classed as *hypabyssal.* This in turn was intruded shortly after its consolidation by various granitic rocks of the region. The seven granitic rock types easily differentiated by their color, texture, and mineral composition are assumed to have been intruded towards the close of the Jurassic. Tertiary clays, known as the Alberhill clays, overlie the various crystalline rocks in the southwest border of the region and Quaternary alluvium is especially prominent in its eastern portion.

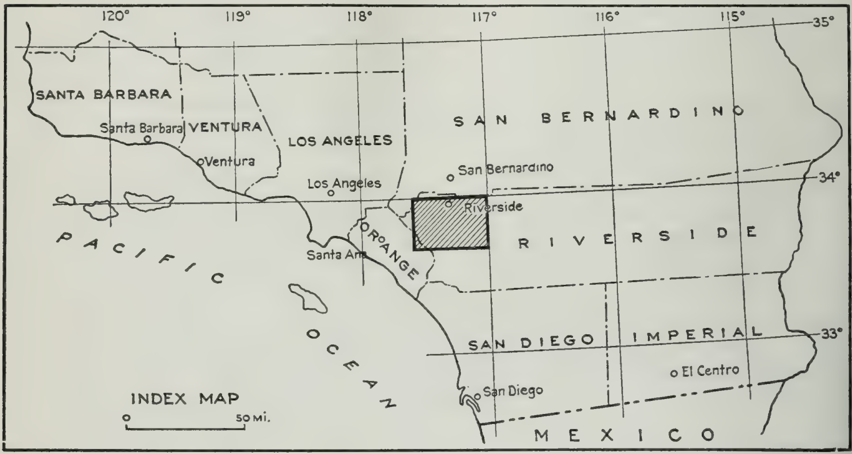
120°
119°
118°
117°
116°
115°
35°
34°
33°
SANTA BARBARA
Santa Barbara
VENTURA
Ventura
LOS ANGELES
Los Angeles
SAN BERNARDINO
San Bernardino
Riverside
RIVERSIDE
ORANGE
Santa Ana
PACIFIC
OCEAN
SAN DIEGO
San Diego
IMPERIAL
El Centro
MEXICO
INDEX MAP
0
50 MI.

FIG. 1. Index map of Southern California, showing the Perris-Elsinore region, covered in this report.

INTRODUCTION

Purpose and Scope.

A brief reconnaissance of the area in 1924 proved that the rock types were sufficiently complex that a study and mapping of them would not only be of scientific interest but would prove a very practical aid to mining interests. Accordingly the examination of the areal distribution and sequence of the major geologic divisions was undertaken. Field and laboratory work was accomplished in 1927–1928.* The main features of the region were described in a paper presented before a meeting of the Cordilleran Section of the Geological Society of America in 1931.[1]

Economic Significance.

It is interesting that this region to which there has been attached a long and persistent economic interest has remained heretofore geologically unmapped. Among the numerous gold mines the Goodhope has had a record of some $2,000,000 production. Equally well known, if not so profitable to date, is the Cajalco Tin Mine, one of the few occurrences of tin on the Pacific Coast.

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* The accompanying geologic map, the result of this work, should be designated Plate VIII.

[1] Dudley, P. H., Geology of a portion of the Perris Block, Southern California: *Abstract,* Bull. Geol. Soc. Amer., vol. 43, p. 223, 1932.

A broad knowledge of the general geological features, a division of the rock types and a knowledge of their sequence is of great importance to successful mineral exploration and mining development. The present report is written with this in view and results of the study present an orderly view of the geology to those interested in mining.

Geographic Location.

The Perris-Elsinore region as defined in this paper is roughly bounded by the towns of Corona, Riverside, San Jacinto and Elsinore. The center of the region, Perris, Riverside County, is approximately 60 miles southeast of Los Angeles. The area is a portion of the geologic structural feature known as the Perris block,[2] which is approximately 20 miles wide and of undetermined length. It is bounded on the northeast by the San Jacinto fault and on the southwest by the Elsinore fault trough. Its most striking surface feature is the so-called Perris peneplain.[3] The study of the region shows, in addition, another distinctly different base level lying at a higher elevation than the Perris surface.

In spite of these old erosional surfaces, much of the Perris block under present consideration, particularly in the southwest portion, has considerable relief.

Previous Investigations.

Geologic references to the Perris-Elsinore region are abundant, but with few exceptions they tend to be of historic rather than technical interest. The first interest attracted to the region was due to various mines, the earliest of which was opened in the fifties.[4] Perhaps the earliest observations on the region are embodied by Whitney in his report of 1865, ''Geological Survey of California.'' He describes his trip through Temescal Canyon, giving observations on the physical aspect of the Perris plain and a note on discovery of tin in the Cajalco district.

The bulk of information on the area is to be found in reports of the California State Mining Bureau,[5] where frequent mention is made of the gold mines, Goodhope, Steele, Gavilan, Virginia, Consolidated C-C, Rosario, etc., and of the tin mine at Cajalco. The most valuable of these reports are those by Goodyear (1888) and Fairbanks (1892); although of reconnaissance nature, they are the first comprehensive discussions of the geology of the region.

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[2] English, W. A., Geology and oil resources of the Puente Hills region, California: U. S. Geol. Survey, Bull. 768, p. 54, 1925.

[3] Dickerson, R. E., The Martinez and Tejon Eocene and associated formations of the Santa Ana Mts.: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 8, p. 259, 1914.

[4] Merrill, F. J. H., Mines and Mineral Resources of Los Angeles County, Orange County, and Riverside County, Calif., 15th Rept. State Mineralogist, Cal. State Min. Bur., pp. 527–8, 1916.

[5] Hanks, H. G., 4th Ann. Rept., pp. 119–22, 1884.
Goodyear, W. A., 8th Ann. Rept., pp. 526–7, 1888; 9th Ann. Rept., p. 151, 1889.
Fairbanks, H. W., 11th Ann. Rept., pp. 106–7, 111–13, 1892; 12th Ann. Rept., pp. 220–5, 1894; 13th Ann. Rept., pp. 310–14, 1895.
Merrill, F. J. H., 15th Rept., pp. 527–35, 547–50, 1916.
Tucker, W. B., 20th Rept., p. 467, 1924; 25th Rept., pp. 495–8, 1929.
Other sources of mention are:
Blake, W. P., Min. Res. of the U. S., U. S. Geol. Survey, p. 434, 1882; p. 610, 1905.
Rolker, C. M., 16th Ann. Rept., U. S. Geol. Survey, p. 536, 1895.
Fairbanks, H. W., Am. Journ. Sci., vol. 4, pp. 39–42, 1897.
Graton, L. C., U. S. Geol. Survey, Bull. 260, p. 165, 1905.
Waring, G. A., U. S. Geol. Survey, Water-Supply Paper 429, p. 15, 1919.
West, H. E., Eng. & Min. Jour., p. 131, July, 1928.

Mendenhall,[6] in 1912, through his work in the Santa Ana Mountains, became the first to clearly recognize the major physical divisions of this general region. He describes this range as being made up of slates and effusives intruded by granites, and the whole overlain by Cretaceous (Chico) sediments. The age of the slates is based on a small collection of fossils made near the mouth of Bedford Canyon which ''although meager, seem abundantly sufficient to determine the Triassic age of the slates.'' He further states, ''the Triassic beds extend considerably beyond the area in the Santa Ana Mountains where they have been carefully examined. Similar beds are known to occur in Railroad Canyon between Elsinore and Perris.''

Waring,[7] in 1919, while making a study of the hydrography of this region, was the first to publish a general geologic map covering it. While he differentiates and maps the surrounding sediments in fair detail, the crystalline rocks are shown merely as an undifferentiated basement complex.

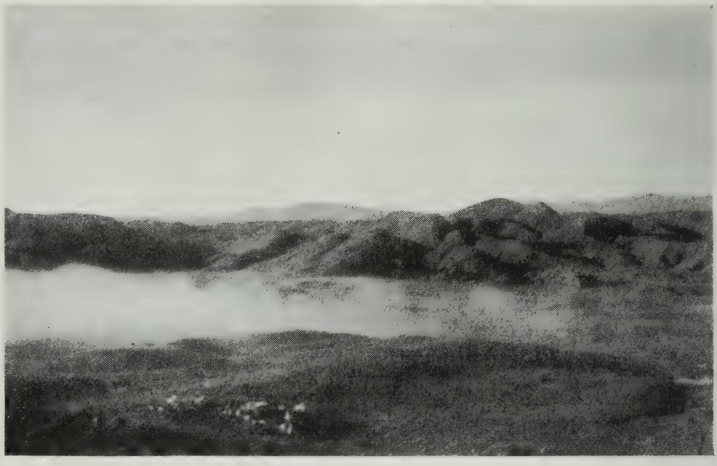

FIG. 2. Looking southwestward across the Gavilan region toward the Santa Ana Mountains in the extreme background. In the immediate foreground is the Perris surface.

In 1931, Engel [8] presented a paper before the Cordilleran Section of the Geological Society of America, which was of interest because it was the first comprehensive study of the geology of the Elsinore trough which bounds the Perris-Elsinore region on the southwest.

ACKNOWLEDGMENTS

Very grateful recognition of the aid and suggestions on this paper should be given to the following: Professor A. O. Woodford of Pomona College; Professors George D. Louderback and Charles A. Anderson of the University of California; Professor Esper S. Larsen of Harvard University; and Messrs. Mason L. Hill, Rollin Eckis, Clifton Johnson, and William C. Hill.

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[6] Mendenhall, W. C., Index to the stratigraphy of North America: U. S. Geol. Survey Prof. Paper 71, p. 505, 1912.

[7] Waring, G. A., Groundwater in the San Jacinto and Temecula Basins, Calif.: U. S. Geol. Survey Water-Supply Paper 429, 1919.

[8] Engel, R., Geology of the southwest quarter of the Elsinore quadrangle: *Abstract,* Bull. Geol. Soc. America, vol. 43, p. 225, 1932.

DESCRIPTIVE AND HISTORICAL GEOLOGY

General Statement.

The rocks of the Perris-Elsinore area are dominantly crystalline. They consist of a series of metamorphics; a porphyry which intruded this series; a group of plutonic rocks intruding the metamorphic series and the porphyry; clays of Eocene age; and Quaternary alluvium. In order of decreasing age, the rock types may be tabulated as follows:

- Quaternary
  - Alluvium
- Tertiary
  - Eocene
    - Alberhill Clays
- Late Jurassic (?)
  - Cajalco quartz monzonite
  - Steele Valley granodiorite
  - Lakeview quartz-hornblende diorite
  - Estelle quartz diorite
  - Perris quartz diorite
  - Gabbro
  - Virginia quartz-hypersthene norite
  - Temescal dacite-porphyry
- Triassic
  - Elsinore metamorphics

The Elsinore metamorphics consist of a variety of meta-sediments and meta-volcanics which precede the intrusive Temescal dacite-porphyry by a distinct time interval. The porphyry, however, was followed so soon by the granitic intrusives that it may be considered a hypabyssal member of this plutonic series. The latter intrusives range from various gabbros into norite and finally into diorites and monzonite. They are not all of simultaneous intrusion, and there is a recognizable sequence between some of them. Their age difference is, however, probably not great, and it is likely that they all were intruded at the same time as the Sierra Nevadan batholith to which slightly different time limits have been given. In the Klamath Mountains, Hinds[9] recently has been able to assign a similar intrusive complex to the comparatively short period between the Mariposa (upper but not latest Jurassic) and the opening of the Cretaceous. It is possible that the Perris-Elsinore plutonic intrusives may be connected with the Peninsular batholith of Lower California, which scattered evidence suggests to be of fairly similar age. Pegmatites and aplites are associated with the more acid intrusives, one of which also contains an important and striking tin-bearing tourmaline segregation. The often highly colored Alberhill clays on the western margin of the area are in part marine (Martinez formation),[10] in part lacustrine,

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[9] Hinds, N. E. A., Jurassic age of the last granitoid intrusives in the Klamath Mountains and Sierra Nevada, Calif.: Am. Journal Science, vol. XXVII, pp. 182–92, 1934.

[10] Moore, B. E., Stratigraphy of the Santa Ana Mts., Calif.: Doctor's Thesis, Calif. Inst. Tech., p. 73, 1930.

Eckis, R., Geology and groundwater of the South Coastal Basin, Southern Calif.: Calif. Div. Water Resources, Bull. 45, 1935.

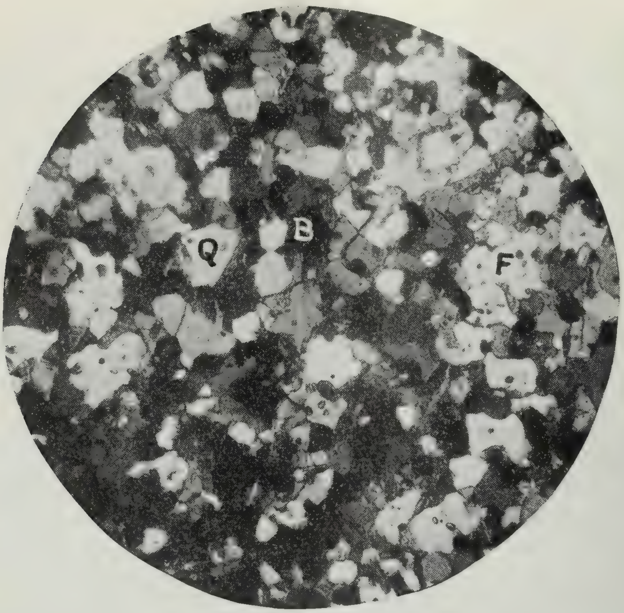

FIG. 3. Photomicrograph of quartz-mica schist, Elsinore metamorphic series. Quartz (Q), feldspar (F), biotite (B). Crossed nicols. Mag. 40 x.

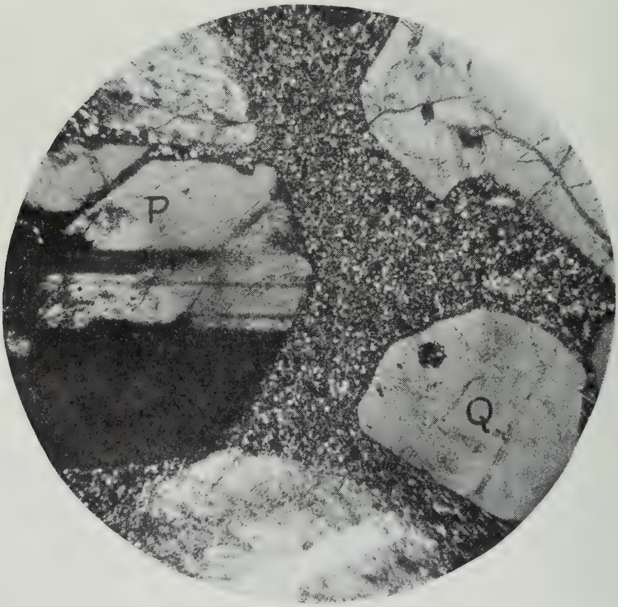

FIG. 4. Photomicrograph of Temescal dacite-porphyry, normal type, with plagioclase (P), and quartz (Q); phenocrysts in a groundmass of plagioclase, orthoclase and quartz. Crossed nicols. Mag. 40 x.

brackish or fresh-water, and likely in part residual.[11] Quaternary alluvium is especially prominent in the eastern portion of the area under consideration.

ELSINORE METAMORPHIC SERIES

Description of the Series.

The above name has been chosen to include all metamorphic rocks in the Perris-Elsinore area. The series is exposed in an arc running north of Elsinore, east through Railroad Canyon, swinging north and then northwest, passing east of Gavilan Mine to be concluded by three large detached remnants lying northwest of Gavilan Mine. An inner irregular crescent lies parallel to this outer one, extending from Alberhill through Goodhope Mine to Steele Valley. A third area of metamorphics occupies the vicinity between Dawson and Cajalco canyons on the western border of the block.

The Elsinore metamorphics constitute a considerable variety of rock types, meta-sediments and meta-volcanics. These range from coarsely crystalline gneisses and schists to slates, granulites, limestones, banded cherts and altered andesitic volcanics.

Schists and Gneisses.

The schists and gneisses extend southward in both of the eastern belts of metamorphics roughly as far as a mile north of Canyon Siding. They also occupy the northwestern two-thirds of the Dawson-Cajalco Canyon area of metamorphics. The rocks under consideration are thoroughly recrystallized. In color they vary from dark brown to almost bluish black. Near intrusives, they are commonly banded, showing *lit-par-lit* injection and the introduction of feldspathic material. In the Cuyamaca region of San Diego County, which is rather similar to this area, Hudson[12] describes injection gneisses associated with andalusite gneiss and quartz-mica sillimanite gneiss in the border areas. He says all gradations exist from pure schist to gneissoid granodiorite. In the Perris-Elsinore area, the schistosity varies from obscure to very distinct. In general, it runs parallel to the original bedding structure. Intricate contortion of the schists on a small scale is not uncommon. The dominant type is represented by a dense, fine-grained quartz-mica schist. Mineral percentages are: quartz 59%, orthoclase 6%, albite 14%, biotite 14%, muscovite 5%, with zircon, apatite, pyrite and magnetite as accessories. The texture is crystalloblastic.

Slates.

The slate facies is dominant in the metamorphics northeast of Alberhill and it occurs in the southeast third of the Dawson-Cajalco Canyon area and finally in Railroad Canyon. The latter two areas present especially well-exposed sections. The slates are predominantly dark-gray. In structure they vary from the general type, where slaty cleavage is distinct but irregular, to the highly fissile slates of Railroad Canyon which are quarried for building purposes. Serrate outcrops projecting through a slaty rubble of weathered mantle are common. Slaty cleavage is generally parallel to original bedding planes; this is best seen in Railroad Canyon where quartzite seams representing original sandy layers are concordant with the slaty cleavage. Near Monument Peak, where the Cajalco quartz monzonite contains segregations of tourmaline, the slates are affected by the local peculiarity of this intrusive. Under the microscope, biotite (about 27% of the slate) is seen to be largely replaced by tourmaline. Rutile is a prominent accessory.

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[11] Waring, G. A., *op cit.*, p. 70, 1919.
Sutherland, J. C., Geological investigation of the clays of Riverside and Orange counties, Southern California, State Mineralogist's Rept. XXXI, January, 1935, p. 63.

[12] Hudson, F. S., Geology of the Cuyamaca region of Calif.: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 13, pp. 184–5, 1922.

Granulites.

Granulites represent a facies of the metamorphics, locally prominent just west of Goodhope Mine, in the region of Arroyo del Toro, and in minor amounts elsewhere. In the main they are rather gray in color. Bedding features are usually present but poorly developed. The rock is resistant to weathering; brownish rugged ledges are common and conspicuous. Certain facies are true quartzites and are of a clear-gray or distinct gray-green color, with notable vitreous luster and pronounced crystalline texture. The dominant type is a medium-gray rather vitreous rock of fine-grained crystalloblastic texture. Ferromagnesian minerals are visible in small amounts. Microscopic examination shows the following minerals: quartz 61%, orthoclase 11%, microperthite 9%, plagioclase (andesine) 5%, augite 4%, hornblende 4%, biotite 4%, with titanite, apatite, zircon, magnetite, ilmenite and allanite (?) as accessories.

Banded cherts and limestones occur locally.

Meta-volcanics.

The meta-volcanics constitute an important facies of the metamorphics, occurring solely in the area immediately northeast, north and northwest of Alberhill. Numerous variations as to color, texture, composition and degree of alteration are to be seen. They vary in color from deep reds and purples to greens and grays. Their texture varies from fine, even-grained, to porphyritic, or to that of a volcanic breccia. In several places, tuff is found. The composition is usually andesitic. Although occasionally fairly fresh, chloritization is a notable characteristic. Despite their usually altered and ancient appearance, they are rather unaffected by the metamorphic forces which not far away have produced the slates.

In San Diego County, Hanna[13] describes a series (Black Mountain volcanics) of massive conglomerates, quartzites, shales, and greenish massive andesitic agglomerates, flows and tuffs, which he says correlates in general with the Triassic of the Santa Ana Mountains as described by Mendenhall. The volcanics, which are virtually greenstones, have little schistosity and are strongly metamorphosed only in the near vicinity of the granitic intrusives. Hudson notes, however, in the Julian series of the Cuyamaca region, metamorphism sufficient to change the subordinate volcanics to "amphibolite schists with distinct schistosity."[14]

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[13] Hanna, M. A., Geology of the La Jolla quadrangle, Calif.: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, pp. 200–1, 1927.

Origin.

Marine origin is attributed to the cherty limestone, the banded cherts, the slates containing concordant limestone lenses, and the poorly bedded granulites; all of which are concordant in attitude with other members of the metamorphic series. The rocks of the schist facies, with their high percentage of quartz, their micaceous minerals and their crystalloblastic texture, are what one would expect as the result of the more complete recrystallization of an impure sandy sediment. Furthermore, the general dip and strike of the schists approximate those of the known slate and granulite, so that there is reason to believe them to be two facies of the same series, differing chiefly in degree of metamorphism.

A few marine fossils have been found by Mendenhall[15] and Hudson[16] in rocks similar to these in nearby areas.

The volcanics, which form a minor portion of the metamorphics, may be in part hypabyssal and in part of surface origin. Volcanic breccia is not uncommon, and tuff is present. In general, these rocks are, however, for the most part, free from flow structure, vesicles or other evidence of surface extrusion. They are at least in part intercalated with the meta-sediments. In general, they exhibit considerable alteration, and therefore have been included as part of the same series.

Structure.

The structure of the Elsinore metamorphic series is not simple. The series is best described as consisting of highly compressed folds, probably in part isoclinal, having a rather characteristic northwest strike, dipping at high angles to the southwest or northeast. There are many local variations from the characteristic strike, but the dips are practically always steep. Local contortion and faulting often complicate the structure.

Although neither the top nor the bottom stratigraphic boundary of the series was found, the relatively large sections of metamorphic rocks exposed indicate that the original series was at least several thousand feet thick.

Types of Metamorphism.

The Elsinore series has undergone both dynamic and contact metamorphism. The former type is represented by rocks possessing slaty cleavage. In the latter the slaty cleavage becomes schistose, and the mineral and textural changes become characteristic of more extreme metamorphism. In the Cuyamaca region, Hudson[17] notes secondary lines of schistosity due to contact metamorphism superimposed on the planes of regional schistosity. Where this has happened sillimanite and andalusite are often present. In the Perris-Elsinore area fissile slates and impure quartzites become quartz-mica schists. Impure limestone lenses become marble and develop contact minerals such as wollastonite.

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[14] Hudson, F. S., *op. cit.*, pp. 183–7, 1932.
[15] Mendenhall, W. C., *op. cit.*, p. 505, 1912.
[16] Hudson, F. S., *op. cit.*, p. 190, 1922.
[17] Hudson, F. S., *op. cit.*, p. 88, 1922,

At the contact of the series with the intrusives, large and small blocks of the metamorphics can be seen in all stages of breaking up and floating away in the once-liquid granitic magma. These fragments are rounded and corroded, and continuous gradations from recognizable schist fragments to *schlieren* are to be seen. Hulin,[18] in his study of the Randsburg quadrangle, cites continuous gradation from angular fragments of the Rand schist included in the Atolia quartz monzonite, to rounded orbicles with granitic texture and the composition of a quartz diorite. It is notable in the Perris-Elsinore region that in many instances swarms of basic inclusions lie close to present schist contacts.[19]

Near the intruded rocks, the plutonic mass often becomes quartzose, its ferro-magnesian content decreases, and its customary hypautomorphic-granular texture becomes either gneissoid or aplitic.

The Elsinore metamorphics appear to represent an intermediate stage between similar rocks described in the Cuyamaca region and those in the Santa Ana Mountains. Their general contortion and the presence of the more highly metamorphosed facies is characteristic of the Cuyamaca region as described by Hudson. Some of the meta-sediments, and especially the meta-volcanics, are more like equivalent rocks in the Santa Ana Mountains, which are relatively slightly metamorphosed or disturbed except where intruded by the granites, where they suffered baking.[20]

Evidence of Age.

The Elsinore metamorphics are the oldest rocks in the Perris-Elsinore area. They are intruded by the various plutonic bodies with which they come in contact and by the Temescal dacite-porphyry. They are unconformably overlain by the Tertiary Alberhill clays. From evidence gathered by Mendenhall [21] and Packard [22] nearby, it is certain that slates, which must be the equivalent of the Elsinore metamorphics, underlie the Upper Cretaceous (Chico). No fossils were found in the present area, but the series is lithologically so similar to the metamorphics of the nearby Santa Ana Range and the Cuyamaca region that it is tentatively correlated with these in age.

The chance that the Elsinore metamorphics may be the equivalent of the pre-granitic rocks in the San Jacinto quadrangle to the east is lessened by the fact that Fraser [23] correlates the latter, on the basis of lithologic similarity, with Paleozoic rocks north of San Gorgonio Pass.

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[18] Hulin, C. D., Geology and ore deposits of the Randsburg quadrangle, Calif.: Cal. State Min. Bur., Bull. 95, p. 36, 1925.

[19] Pabst, A., Observations on inclusions in the granitic rocks of the Sierra Nevada: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 17, pp. 335–6, 1928—discusses this general phenomenon.

[20] Woodford, A. O., The San Onofre Breccia, its nature and origin: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, pp. 171–2, 1925.

Moore, B. E., Stratigraphy of the Santa Ana Mountains, California. Unpublished doctor's thesis, Calif. Inst. Tech., pp. 15, 25–31, 40–2, 1930.

[21] Mendenhall, W. C., *op. cit.*, p. 505, 1912.

[22] Packard, E. L., Faunal studies in the Cretaceous of the Santa Ana Mts. of Southern Calif.: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, 1916.

[23] Fraser, D. Mc., Geology of the San Jacinto quadrangle south of San Gorgonio Pass, Calif.: Mining in Calif. (Calif. Dept. Nat. Res., Div. Mines) 27, pp. 494–540, 1931.

Description of this series in the San Jacinto quadrangle, which shows an absence of volcanic rocks and the presence of large limestone bodies, further substantiates its difference from the Elsinore metamorphics.

TEMESCAL DACITE-PORPHYRY

Description.

The dacite-porphyry occurs in two bodies bordering Temescal Canyon, the larger of which is pierced by the Estelle quartz diorite.

In contrast to the ancient volcanics of the Elsinore metamorphics, the Temescal dacite-porphyry is of very fresh appearance. It contains abundant white feldspar and quartz phenocrysts averaging 2 mm. in size lying in a gray micro-crystalline groundmass. The microscope shows: plagioclase (andesine) 38%, orthoclase 24%, quartz 30%, biotite 6%, hornblende 1%. Phenocrysts, mainly of plagioclase (andesine), average about 40% of the rock, with minor quartz and sparse orthoclase, biotite and hornblende phenocrysts. The groundmass is mainly quartz and orthoclase in equal proportions with subordinate plagioclase (andesine). Biotite is present in minor amounts as well as the accessories magnetite, ilmenite, apatite, titanite and rutile. Without the benefit of chemical analysis the rock has been tentatively classified as dacite-porphyry.

There are minor facies of the Temescal dacite-porphyry which vary from types with coarse phenocrysts and phanerocrystalline groundmass to those with small phenocrysts and aphanitic groundmass.

Origin.

Field evidence shows the normal Temescal dacite-porphyry to represent an intrusive mass. Its texture would suggest that it came to rest at intermediate depths and cooled rather evenly throughout. The fine-grained minor facies may represent marginal chill zones or perhaps near-surface or actual surface outbreak.

Intrusive Effects.

The extent of the contact metamorphism by the porphyry is not generally clear. In the two places at which such features could be studied, the Elsinore series was clearly affected, with the production of hornfels and mica schists. It is noteworthy that at one locality where the contact is very well exposed, the porphyry contains many basic inclusions which represent nearly assimilated fragments of schist. The phenomenon is similar to the orbicular diorite produced along intrusive contacts with plutonic masses in other parts of the area studied. That the contact metamorphic effects in general were not so widespread nor so severe as in the case of the plutonic invasions is seen by the fact that usually, within 200–600 yards from the porphyry contact, the metamorphism of the Elsinore series is only of the dynamic type. The ancient volcanics with which the Temescal porphyry comes in contact are little affected.

Effects of Other Igneous Intrusions on the Porphyry.

In view of the contact metamorphic effects of the various plutonic bodies on the rather resistant rock types of the Elsinore metamorphics,

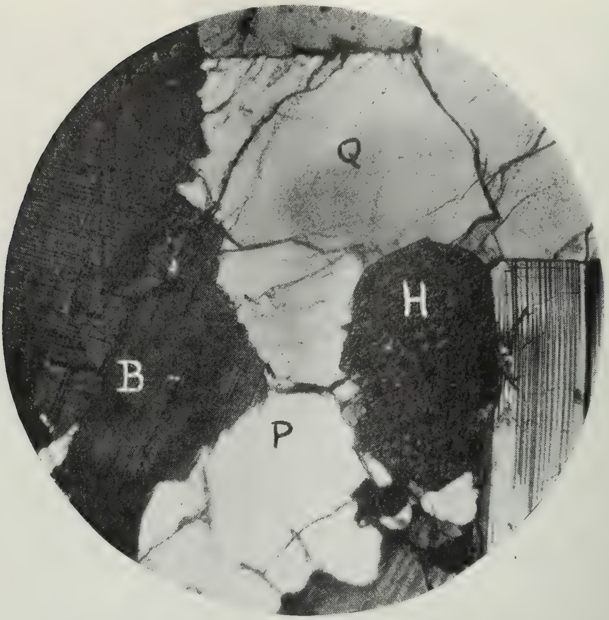

FIG. 5. Photomicrograph of Perris quartz diorite, with plagioclase (P), quartz (Q), biotite (B), hornblende (H). Crossed nicols. Mag. 40 x.

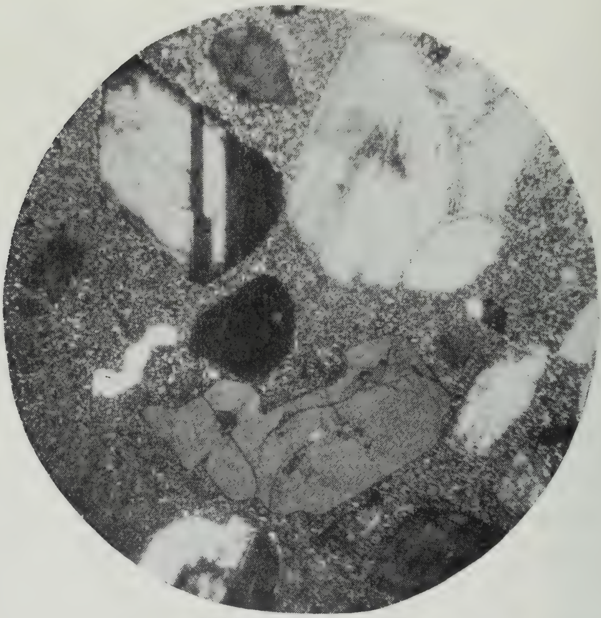

FIG. 6. Photomicrograph of Temescal dacite-porphyry, normal type. Crossed nicols. Mag. 18 x.

it is noteworthy that the porphyry is fresh and unaltered within an inch of intrusive contacts. In cases involving three different plutonic bodies, this intrusive relation and its effects are so clear as to permit tracing by pencil.

Evidence of Age.

The Temescal porphyry intrudes the Elsinore slates. This holds true for not only the normal porphyry but also for the minor dacitic facies which came in contact with the slates. The porphyry also intrudes the ancient volcanics of the Elsinore series. In a particularly clear case, the porphyry shows evidence of mild primary flow structure within 3 inches of, and parallel to, the contact. Fragments of the ancient volcanics are seen broken off and embedded in the porphyry and rounded by assimilation. Apophyses of the porphyry reach out into the older rocks. There is little evidence of marginal chilling in the normal porphyry intrusive.

Aside from the above direct field evidence, there is other evidence of the relatively younger age of the Temescal porphyry. Although much of the Elsinore series is affected by dynamic and contact metamorphism, the porphyry, over its wide area, is absolutely unaffected by such agencies.

Cut by jagged apophyses of the plutonic bodies and included as fragments in them, the Temescal porphyry is clearly intruded by the following: (1) The Estelle quartz diorite, (2) the Steele Valley quartz diorite, (3) the Cajalco quartz monzonite. Although it also comes in contact with the Perris quartz diorite, the Virginia quartz-hypersthene norite, and the gabbro, the exact line of such contact is in all cases imperfectly exposed.

The Temescal porphyry is pre-Cretaceous (Chico) because fragments of it are to be seen in conglomerates of this age in the Santa Ana Mountains.

Correlation.

Mendenhall [24] in his reconnaissance work in the Santa Ana Mountains, speaking of the slate series as sparingly intruded by a series of medium acidic dikes and overlain unconformably by associated effusives whose aspect is andesitic or slightly more acidic, fails to mention anything similar to the dacite-porphyry. Moore,[25] describing several types of volcanics mainly on the southwest side of the Santa Ana Mountains, mentions none which correspond to the Temescal dacite-porphyry, except a dacite which might possibly correspond to one of its minor types. Fairbanks [26] describes "a dark-colored porphyry * * * with small white feldspar crystals, producing a very pretty effect," part of an ancient series of pre-granitic volcanics lying along the Otay River in San Diego County. Several reasons suggest, however, that this rock is unrelated to the Temescal dacite-porphyry. Beyond this, no mention of anything similar in neighboring areas is to be found.

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[24] Mendenhall, W. C., *op. cit.*, p. 505, 1912.

[25] Moore, B. E., *op. cit.*, p. 42, 1930.

[26] Fairbanks, H. W., Geology of San Diego County; also portions of Orange and San Bernardino counties, Calif.: 11th Ann. Rept. State Mineralogist, Cal. State Min. Bur., p. 77, 1892.

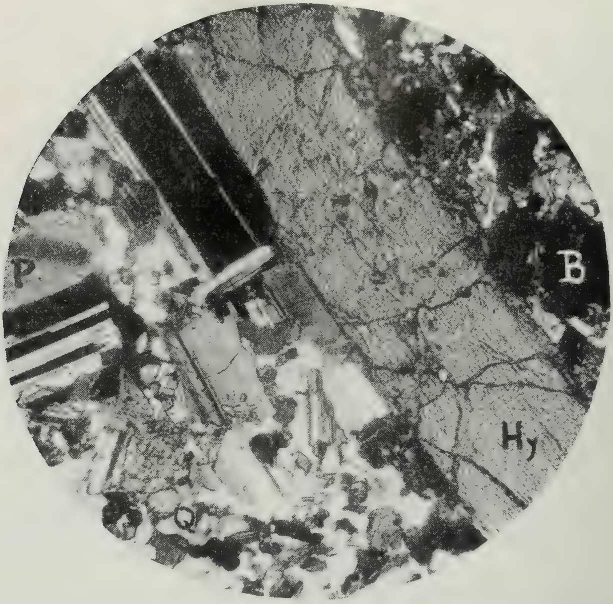

FIG. 7. Photomicrograph of Virginia quartz-hypersthene norite, with hypersthene (Hy), plagioclase (P), biotite (B), quartz (Q). Crossed nicols. Mag. 40 x.

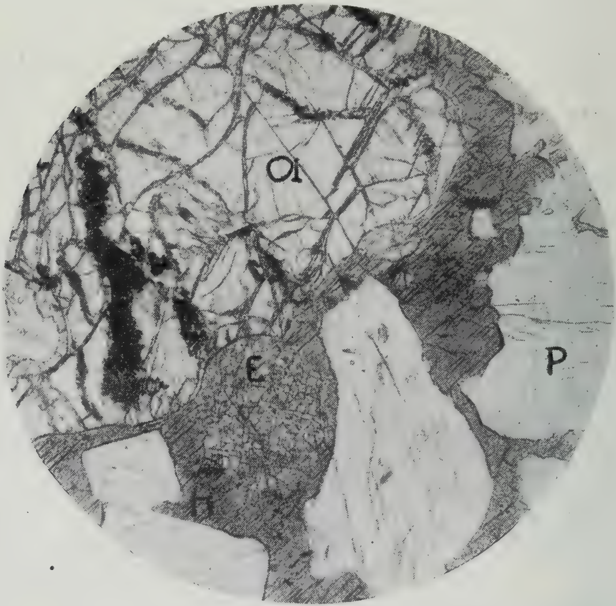

FIG. 8. Photomicrograph of gabbro (olivine-enstatite eucrite), with plagioclase (P), olivine (Ol), enstatite (E), hornblende (H). Crossed nicols. Mag. 48 x.

VIRGINIA QUARTZ-HYPERSTHENE NORITE

The Virginia quartz-hypersthene norite was so named because the most important body occurs near the old Virginia Mine and extends west from there up into the eastern part of the Gavilan. The name, however, is applied also to the other body lying on the southwestern edge of the Perris fault block.

The Virginia quartz-hypersthene norite is a rock of very constant character. It has a peculiar dark color and weathers rather distinctively, assuming a bronze cast. Its texture is coarse hypautomorphic granular. Microscopic examination shows its mineral composition to be: plagioclase (labradorite) 51%, orthoclase 6%, quartz 14%, hypersthene 12%, biotite 8%, augite and hornblende 6%, with rather plentiful accessories such as zircon, apatite, rutile and magnetite.

GABBRO

There are four rather widely separated masses of gabbro present; small bodies appearing (1) two miles east of Railroad Canyon, (2) one mile east of the Gavilan Mine, (3) at Gavilan Peak and in its vicinity and, (4) a large body lying between Arlington Mountain and Mockingbird Canyon.

These gabbros are often found to possess pronounced gabbroic texture and vary from light to dark in color. Portions become hornblende gabbros of coarse grain, with a composition of plagioclase (bytownite) 45%, hornblende 52%, and accessories such as magnetite, rutile and zircon. Other portions become virtually basic diorites with a hypautomorphic granular texture. One variety is an olivine-enstatite eucrite which microscopic examination shows to have the following composition: plagioclase (basic bytownite) 48%, augite 15%, enstatite 9%, hornblende 17%, olivene 10%, with magnetite an accessory.

PERRIS QUARTZ DIORITE

This is the most common and widespread rock type of the region, extending over most of the Perris surface. It extends from Mockingbird Canyon on the west, through Box Springs Mountains to the major fault bounding the Perris block on the northeast. It reaches commonly as far south as Goodhope Mine, Perris and the Lakeview Mountains.

As a rock type, it is quite constant in composition and appearance. It is easily recognizable from the other plutonic intrusives by its steady gray color, moderately coarse texture and noticeably more prominent content of biotite. In general appearance and size of grain, it nearest resembles the Estelle quartz diorite. However, in the hand specimen, the ferromagnesian minerals of the latter are greenish and quartz is not so prominent. The Cajalco quartz monzonite is of much coarser texture and more flesh-colored than the Perris quartz diorite. The Steele Valley granodiorite is equally easy to distinguish from the latter, in that it is much whiter and of fresher appearance. The Lakeview diorite is white in color, contains prominent hornblende and is much coarser than the Perris quartz diorite. Microscopic examination of a representative specimen of the latter shows the following mineral content: plagioclase (andesine) 54%, orthoclase 5%, quartz 19%, hornblende 11%, biotite 10%, with titanite, zircon, apatite, magnetite as accessories.

ESTELLE QUARTZ DIORITE

The Estelle quartz diorite occurs in the first valley to the east of Estelle Mountain, whence its name. It pierces the Temescal dacite-porphyry and has been exposed by erosion which has trenched a fair-sized valley through the heart of that mass.

Two reasons justify separate consideration of the rock type composing the Estelle intrusive: (1) the intrusive is a very distinct field unit, (2) although showing up under microscopic analysis to be rather similar to the Perris quartz diorite, the rock has a distinctly different appearance in hand specimen. A thin section of a representative specimen shows its composition to be as follows: plagioclase (andesine-labradorite) 41%, orthoclase 7%, microperthite 5%, quartz 27%, hornblende 11%, biotite 8%, with magnetite, ilmenite, zircon, titanite and apatite as accessories.

LAKEVIEW QUARTZ-HORNBLENDE DIORITE

This rock type is found throughout the greater portion of the Lakeview Mountains.

The Lakeview quartz-hornblende diorite is very constant in composition and easy to recognize by virtue of its very coarse crystalline structure, white feldspar, abundant large quartz and large hornblende crystals. By this last mineral it is quickly distinguished from the other plutonics of this area, all of which have biotite as their prominent ferromagnesian mineral. Microscopic examination shows the following composition: plagioclase (andesine to labradorite) 60%, quartz 29%, hornblende 4%, biotite 6%, with accessories titanite, zircon, apatite and magnetite.

STEELE VALLEY GRANODIORITE

The Steele Valley granodiorite was so named because of its occurrence at this locality in the southern part of the Perris-Elsinore area.

The rock type composing the Steele Valley intrusive has very little variation. It is a distinctive type and contrasts with the other plutonic intrusives in that it is much lighter in color, being nearly white. *Schlieren* are almost wholly absent in both this and the Estelle intrusive, in contrast to their common occurrence in the Perris quartz diorite. The granodiorite possesses a medium-grained granitic texture. Microscopic examination shows its composition is: plagioclase (calcic oligoclase) 37%, microcline and microperthite 24%, quartz 33%, biotite 4%, amphibole 2%, with titanite, apatite, magnetite, rutile and zircon as accessories.

CAJALCO QUARTZ MONZONITE

This intrusive covers the fairly large area between Monument Peak and Arlington Mountain, including Cajalco Canyon.

Although the Cajalco quartz monzonite is not an extremely uniform rock type it is fairly constant in mineral composition. It is quite easily recognized in the hand specimen, because of its usually coarse crystalline texture, its flesh to pinkish orthoclase, its prominent quartz and rather constant small amount of biotite. Microscopic examination of a representative specimen shows: plagioclase (oligoclase to andesine) 30%, orthoclase 25%, quartz 40%, biotite 3%, and sparse accessories such as magnetite, zircon, titanite and apatite.

Between the Cajalco Tin Mine and Monument Peak, a tourmalinized zone is present in the quartz monzonite. Near the latter locality the rocks likely represent a late magmatic stage, for the quartz monzonite locally becomes a very acid tourmaline diorite and dikes of nearly pure tourmaline are present. All gradations from granitic rocks to tourmalinized porphyry are seen. Tourmalinized quartz segregations are present as variations.

SEQUENCE AND CORRELATION OF THE PLUTONIC ROCKS

As has been previously stated, the seven different plutonic bodies all intrude the Elsinore metamorphics. Three of these bodies intrude the Temescal porphyry; three (Virginia norite, gabbro, Perris quartz diorite) come in areal contact with the porphyry, but the exact relations are undeterminable; one (Lakeview diorite) is not contiguous with the porphyry.

Because of broad field evidence and known relations of comparable intrusive complexes it is reasonable to assign the plutonic bodies of the Perris-Elsinore area a general similar age. While each intrusive does not come in contact with every other one, evidence is sufficient to establish some sequence within the group.

The Virginia quartz-hypersthene norite comes in contact with the Perris quartz diorite. In the norite body on the western edge of the Perris block there is evidence of gradation between the two intrusives. In the other body near Virginia Mine, however, each intrusive tends to maintain a distinct identity and there is the suggestion that the norite is cut by the Perris quartz diorite. The norite, therefore, tentatively has been placed as contemporaneous or older than the latter.

The gabbro bodies, which are assumed to be contemporaneous with each other, come in contact with the Perris quartz diorite and Cajalco quartz monzonite. Within the body east of Gavilan Mine there is variation from gabbro with pronounced gabbroic texture to basic diorite with hypautomorphic granular texture. In places here, there is the suggestion that the mass finally grades into Perris quartz diorite, being in reality a contemporaneous differentiation facies. Again, in another locality, both intrusives maintain their identity up to the contact and blocks of gabbro are included in diorite. The gabbro has therefore tentatively been assigned an age equivalent or possibly older than the Perris intrusive. It is clearly earlier than the Cajalco quartz monzonite which in other localities intrudes it.

In addition to the norite and gabbro, the Perris quartz diorite comes in contact with the Lakeview quartz-hornblende diorite, the Steele Valley granodiorite and the Cajalco quartz monzonite. Available evidence indicates that it is older than the Lakeview diorite which intrudes it. Its relation with the Steele Valley intrusive is undeterminable because the line of contact is covered with soil mantle. The Caljalco quartz monzonite intrudes the Perris quartz diorite.

The Estelle quartz diorite, as has been previously stated, comes in contact with no other plutonic mass.

The Lakeview intrusive comes in contact only with the Perris quartz diorite. Its tentative later age is based on the finding of fractured blocks of the latter included in the fresher Lakeview intrusive.

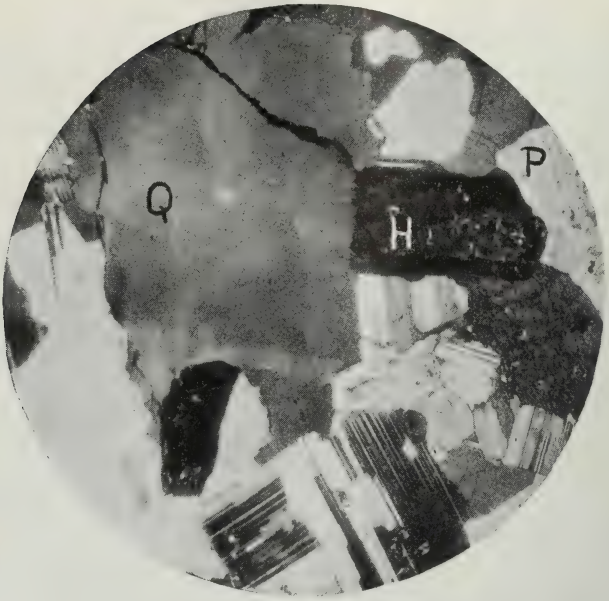

FIG. 9. Lakeview quartz-hornblende diorite, with quartz (Q), plagioclase (P), hornblende (H), etc. Crossed nicols. Mag. 18 x.

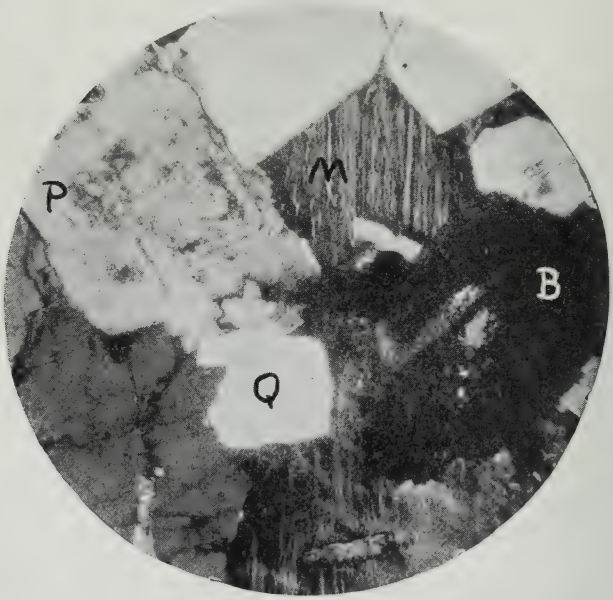

FIG. 10. Steele Valley granodiorite, with plagioclase (P), microperthite (M), quartz (Q), biotite (B), etc. Crossed nicols. Mag. 40 x.

That these intrusives are different, rather than being variations of the same intrusive, is further indicated by the fact that each tends to maintain its own individual appearance and composition up to the general line of contact.

The Steele Valley granodiorite comes in contact solely with the Perris quartz diorite. As has been stated, the relative age of the two is not known. Since each type maintains its identity up to the boundary, even although the actual contact can not be seen, it would appear that the Steele Valley intrusive is not a differentiation phase of the Perris quartz diorite. For convenience alone it has been placed as later than the Perris intrusive.

The Cajalco quartz monzonite comes in contact with the gabbro and the Perris quartz diorite. Apophyses of it cut both of these intrusives and fragments of gabbro and diorite in various stages of assimilation are included in the monzonite at different localities. While the latest rock which it cuts is the Perris quartz diorite, the monzonite has been tentatively placed as the latest of the series because it is the most acid of the intrusive group.

It is fair to assume that the above plutonic family was intruded within rather narrow geologic time limits. All of its members intrude the Triassic Elsinore series which is in turn overlain by the unconsolidated Alberhill clays of Eocene age. The granitic intrusives in the Santa Ana Mountains are proven post-Triassic and pre-Cretaceous (Chico) and their proximity fully justifies assigning this age limit to the plutonic rocks of the Perris-Elsinore area. Thus these may be correlated reasonably with the Sierra Nevadan batholith, or possibly the Peninsular batholith of Lower California. In considering the age of the plutonic rocks of southern California, Fairbanks believes that the granitic invasion ''took place as it did in central and northern California between the Cretaceous and the Jurassic'' and that there is no break in the line of granites and crystalline schists the whole length of California.[27]

ECONOMIC GEOLOGY

The economic resources of the Perris-Elsinore area are varied. The Eocene Alberhill clays, representing the most dependable source of clays in southern California, have recently been described in detail by Sutherland.[28] Other nonmetallic minerals occur in the area, such as the magnesite deposit near Winchester, and quartz and feldspar in pegmatites in the Lakeview Mountains.

Certain of the rock types themselves are of potential value as construction or monumental material. When crushed, the Temescal dacite-porphyry forms excellent material for road building. The Blue Diamond Company has a large quarry located in the porphyry near the northwest corner of the area. Since this rock type is very constant, hauling and loading costs are practically the only factors in consideration of establishment of quarries in other sections.

Quarrying of the granitic rocks for monumental purposes has been carried on in various places throughout the area. Since such rocks possess certain variations, the profitable location of a quarry depends on several factors besides loading and hauling costs to market. These include the degree of chemical weathering of the rock and the direction and amount of jointing in it. The granitic types in the Perris-Elsinore area which offer possibilities for monumental quarrying because of their texture and appearance are particularly the Virginia quartz-hypersthene norite and the Steele Valley granodiorite. These possess an even texture, are usually very fresh and possess few *schlieren.* The former rock is quarried near the old Virginia Mine. The latter, although it is an unusually pretty rock type, is not of potential economic value because of its inaccessibility. Under certain conditions the gray Perris quartz diorite and the pinkish Cajalco quartz monzonite form attractive monumental material. The areal extent of these is such that they have more favorable economic locations.

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[27] Fairbanks, H. W., *op. cit.*, p. 119, 1892.

[28] Sutherland, J. Clark, Geological investigation of the clays of Riverside and Orange counties, Southern Calif.: Cal. State Div. Mines, State Mineralogist's Rept. XXXI, Cal. Journ. Mines and Geol., January, 1935.

Because of the infrequent occurrence of tin on the Pacific Coast, the existence of cassiterite in the Perris-Elsinore area is of more than passing interest. The best description of its occurrence, at the Cajalco Tin Mine, is that given by Fairbanks.[29] The mine has had a rather erratic history under several different managements, and most of the time in recent years it has not been in operation. The deposit is essentially a tin-impregnated tourmaline vein. Examination of the area shows that the tourmaline-bearing vein, or segregation with which the tin is associated, is confined to the Cajalco quartz monzonite. This is the most acid, and likely the latest, of the seven granitic intrusions. This tourmaline-bearing vein extends in interrupted fashion several miles south of the mine.

Gold mining has been carried on in the area since the fifties, a very substantial amount of production once having been attained by the Goodhope Mine which lies 5 miles northeast of Elsinore. Brief reference to this and the other numerous smaller mines in the area is found mainly in various reports of the California State Mining Bureau already referred to. Production in all cases comes from gold-bearing quartz veins of deep-seated origin. Gold values are not dependent on the size of the veins, but rather on their nature. It is a general rule that as the feldspar content of the veins increases and as they become more aplitic in character, the chances of gold values become progressively less. The productive quartz veins happen to be associated almost exclusively with the Perris quartz diorite. The Cajalco quartz monzonite, the Estelle quartz diorite and Lakeview quartz-hornblende diorite have some associated veins, but these tend to be pegmatitic or aplitic and apparently are rather devoid of gold values. The Virginia quartz-hypersthene norite and Steele Valley granodiorite have virtually no associated veins of any nature. The Temescal dacite-porphyry, which is closely associated with the granitic intrusives, has few associated veins.

The lack of continuity in the veins rather than offset due to faulting, appears to be a normal characteristic of the veins in the igneous rocks. Although the Perris block is bounded by important faults, the block itself has remained essentially rigid and within it displacements of any size or importance are rare.

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[29] Fairbanks, H. W., *op. cit.,* pp. 106–113, 1892.
Tin deposits in Temescal: Am. Journ., Sci., (4) vol. 4, 1897.

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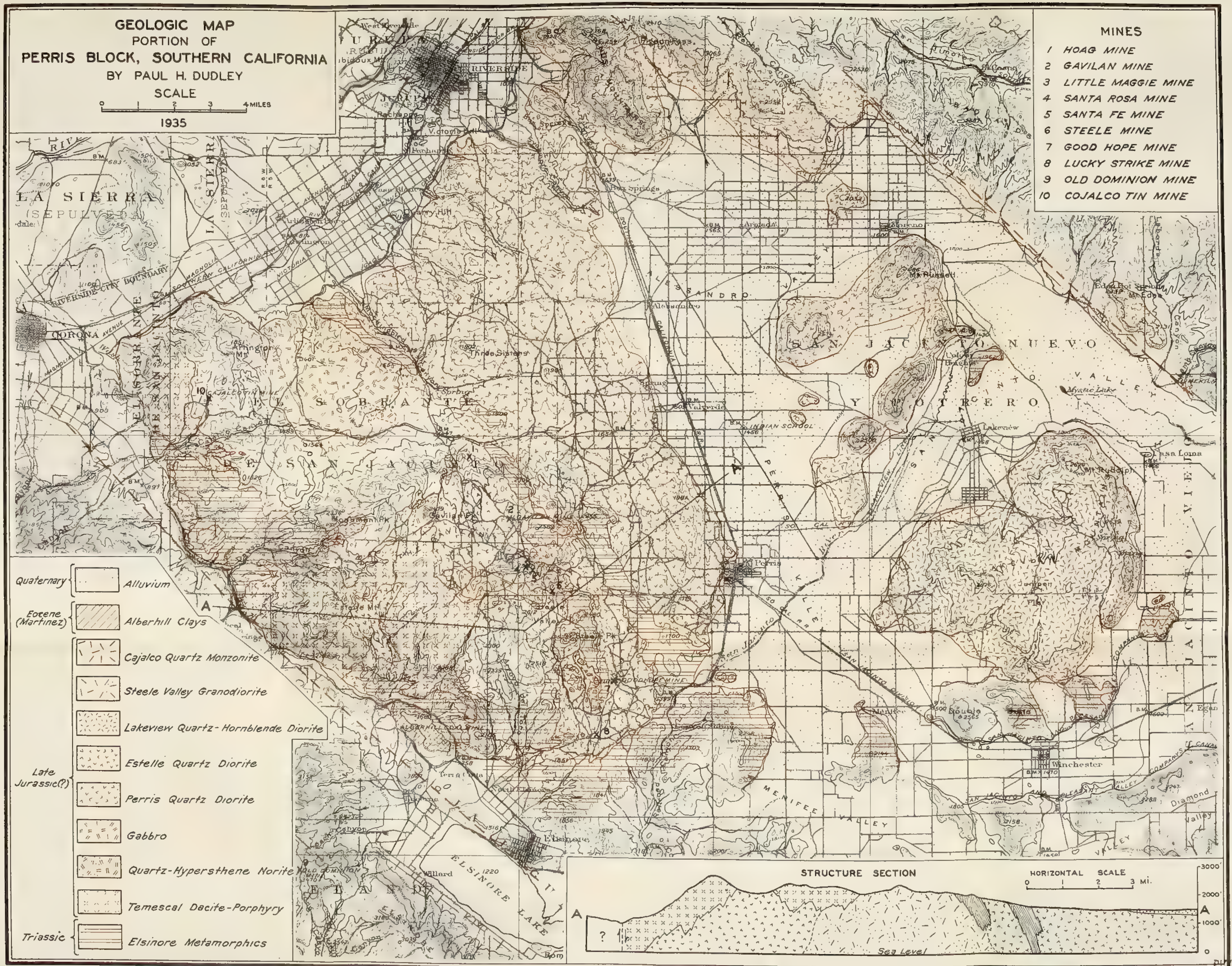
GEOLOGIC MAP
PORTION OF
PERRIS BLOCK, SOUTHERN CALIFORNIA

BY PAUL H. DUDLEY


SCALE
0 1 2 3 4 MILES
1935
RIVERSIDE
Jurupa
Corona
LA SIERRA (SEPULVEDA)
RIVERSIDE CITY BOUNDARY
EL SOBRANTE DE SAN JACINTO
SAN JACINTO NUEVO Y POTRERO
Alessandro
Moreno
Mt. Russell
Mystic Lake
Lakeview
Mt. Rudolph
Casa Loma
Perris
Perris Valley
Menifee Valley
Winchester
Elsinore
Elsinore Lake
Gavilan Pk
Estelle Mt
Steele Pk
Arlington
Box Springs
Three Sisters
Indian School
Double Butte
Diamond Valley
STRUCTURE SECTION
HORIZONTAL SCALE
0 1 2 3 Mi.
3000'
2000'
1000'
0
Sea Level
A
A
?

MINES

1 HOAG MINE
2 GAVILAN MINE
3 LITTLE MAGGIE MINE
4 SANTA ROSA MINE
5 SANTA FE MINE
6 STEELE MINE
7 GOOD HOPE MINE
8 LUCKY STRIKE MINE
9 OLD DOMINION MINE
10 COJALCO TIN MINE

Quaternary	☐	Alluvium
Eocene (Martinez)	▨	Alberhill Clays
Late Jurassic(?)	▨	Cajalco Quartz Monzonite
	▨	Steele Valley Granodiorite
	▨	Lakeview Quartz-Hornblende Diorite
	▨	Estelle Quartz Diorite
	▨	Perris Quartz Diorite
	▨	Gabbro
	▨	Quartz-Hypersthene Norite
	▨	Temescal Decite-Porphyry
Triassic	▤	Elsinore Metamorphics

ACCOMPANYING REPORT BY PAUL H. DUDLEY AND R. J. SAMPSON.
STATE MINERALOGIST'S REPORT XXXI. OCTOBER 1935.

TOPOGRAPHY AFTER U.S.G.S.

MINERAL RESOURCES OF A PORTION OF THE PERRIS BLOCK, RIVERSIDE COUNTY, CALIFORNIA*

By R. J. SAMPSON, Mining Engineer

Location and General Features.

This block, which is situated some 60 miles southeast of Los Angeles, is largely in Riverside County. It includes, however, a small portion of Orange County in its extreme southwestern corner. The dimensions of the block are approximately 25 miles in a north-south direction and 30 miles in an east-west direction.

The principal towns in the area are Elsinore and Perris.

The topography is that of a gently rolling plain some 18 or 20 miles in length, flanked on either side by more or less continuous ranges of low hills. Elevations range from 1300 feet on the peneplain to 2800 feet on the highest hill. The climate is mild, with rather high temperatures in the summer.

It is accessible in almost every portion over good highways, most of which are paved.

Mineral Deposits.

Probably the most important deposits in this area are the Alberhill clays. Some gold has been produced. Other than the Good Hope and possibly the Gavilan mines, little of importance has been developed.

Considerable quantities of feldspar have been shipped from the vicinity of Lakeview and some monumental granite has been quarried.

Perhaps the most interesting feature of the entire area is the occurrence of tin at the Cajalco Tin Mine. Some small production of tin was made from this property years ago but recent expenditure of a considerable sum of money failed to uncover a commercial orebody.

In the following pages the metal mines are briefly described in alphabetical order after which the nonmetallic deposits are discussed in the same order. Locations of the mines are indicated on the geological map, Plate VIII, accompanying the report of Paul H. Dudley, 'Geology of a Portion of the Perris Block, Southern California,' which precedes the present paper in this issue of the JOURNAL.

GOLD

During the period 1876 to 1885 there was considerable activity in the area west and southwest of Perris. This is known as the Pinacate mining district. The total production is not known but it was probably about $2,500,000.

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* This economic report supplements the foregoing account of the 'Geology of a Portion of the Perris Block, Southern California,' by Paul H. Dudley. See accompanying geologic map (should be designated "Plate VIII").

Mines.

Alice Mine. It is 4 miles south of Menifee. Elevation 1500 ft. Owner, J. S. Egan Estate, Perris, California.

Idle.

Bibl: State Mineralogist's Reports XII, p. 221; XIII, p. 310; XV, p. 534; XXV, p. 472.

Colorado Mine (*Justice*), comprising one patented claim is in Sec. 32, T. 4 S., R. 4 W. Owner, Luke J. MacNamee, 431 Pacific Electric Bldg., Los Angeles. Under lease and bond to F. Sandoval, 1315 Angeles Ave., Hollywood, California.

A vein, 4 to 12 inches wide, strike NW., dip 11° to the southwest, occurs in the granite.

Developed by a slope 280 ft. on 11° inclination. At this depth the vein straightens to 33° dip. At the 205-ft. level there is a drift 180 ft. long. This has been stoped to the surface. Average grade of ore reported to be $10 to $14 per ton, with some ore carrying as much as $500 per ton.

There is a Chilean type of mill and plates, having a capacity of 8 to 10 tons per day.

Six men are employed.

Bibl: State Mineralogist's Reports XIII, p. 310; XV, p. 531; XXV, p. 483.

Gavilan Mine (now *Ida Leona Mine*) is situated 6 miles west of Perris on the old Rancho Sobrante de San Jacinto. Elevation about 2000 ft.

After having been worked by Mexicans with arrastres for many years, this property was reopened and worked by a Riverside company from 1890 to 1892. The workings reached a depth of about 485 ft. and some production was made.

Now under lease to H. L. Nelson and sons, 3147 Second St., Riverside, California.

The present lessee has sunk a new shaft about 300 ft. south of the old Gavilan shaft. The shaft was sunk 50 ft. on 66° inclination to the south, then vertically to 110 ft. On the 50-ft. level a drift has been driven 40 ft. east and 30 ft. west. On the 100-ft. level, a crosscut was driven 20 ft. to the vein and drifts 60 ft. east and 35 ft. west. These workings were under water at the time of visit. They are now unwatering this shaft, after a year's idleness. They propose to sink to 300 ft. and develop both the Ida-Leona and Gavilan veins at this depth. The Ida-Leona is thought to be an offshoot from the Gavilan vein.

In the earlier operations of the present lessee, a small mill was erected and some production made from the Ida-Leona vein, reported to be about 8 inches wide and carrying about $50 per ton.

The mill contained the following equipment: 25-ton bin; crusher; 4 by 5 ft. Marcy mill (has been removed from the property); Gibson amalgamator; Simplex-Dorr type classifier; Wilfley table. Power is supplied by 75-h.p. Holt engine.

Other equipment consists of 15-h.p. gas engine hoist and 309-cu. ft. Chicago pneumatic air compressor. A Worthington boiler-feed pump is suspended in the shaft.

Three men are employed unwatering the mine.

Bibl: State Mineralogist's Reports XI, pp. 334–337; XIII, p. 311; XV, p. 528; XXV, p. 478.

Golden Chariot Mine is 5 miles southwest of Perris, adjoining the Santa Rosa on the southwest. It was developed by a shaft 310 ft. deep. Idle.

Bibl: State Mineralogist's Reports XIII, p. 311; XXV, p. 479.

Good Hope Mine is situated in Sec. 15, T. 5 S., R. 4 W., S. B. M., 4½ miles southwest of Perris, in the Pinacate mining district. Owner, Velna A. Teater, Los Angeles. Held under purchase contract by the Good Hope Development Co., James M. Hyde, president; Clifford H. Marker, secretary, 1015 Security Bldg., Los Angeles.

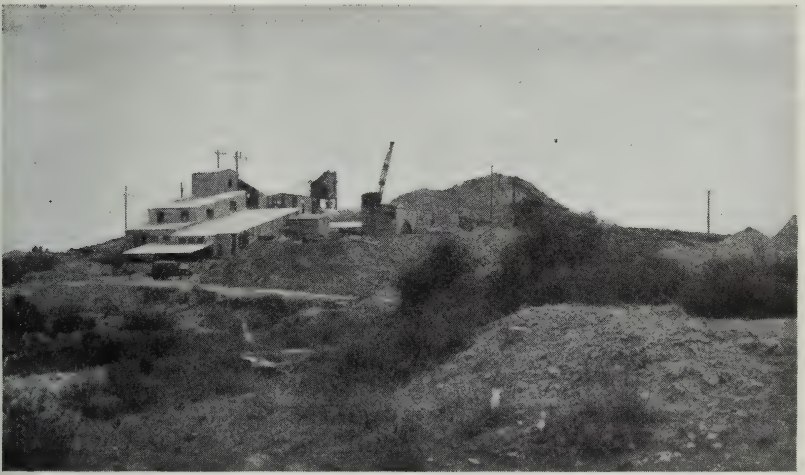

FIG. 1. Good Hope Mine and Mill, Riverside County.

Photo by courtesy of James M. Hyde.

This is an old property originally worked by Mexicans. As early as 1894 it was being worked to a depth of 485 ft. At this time it was equipped with a 20-stamp mill and other surface equipment. By 1896 the property was shut down and in litigation. No further work was done, with the exception of some desultory mining by leasers and the treatment of tailings by cyanide until the present operators took over the property in 1933. Our Fifteenth Report, page 527, credits this property with a production of $2,000,000.

The country rock in the vicinity of the Good Hope mine is granitic. In this granodiorite occur dikes, apparently felsitic phases of the same magma which formed the main mass.

There are two sets of north-south veins on the property. The easterly set, known as the Good Hope, dips 55° W. About one-half

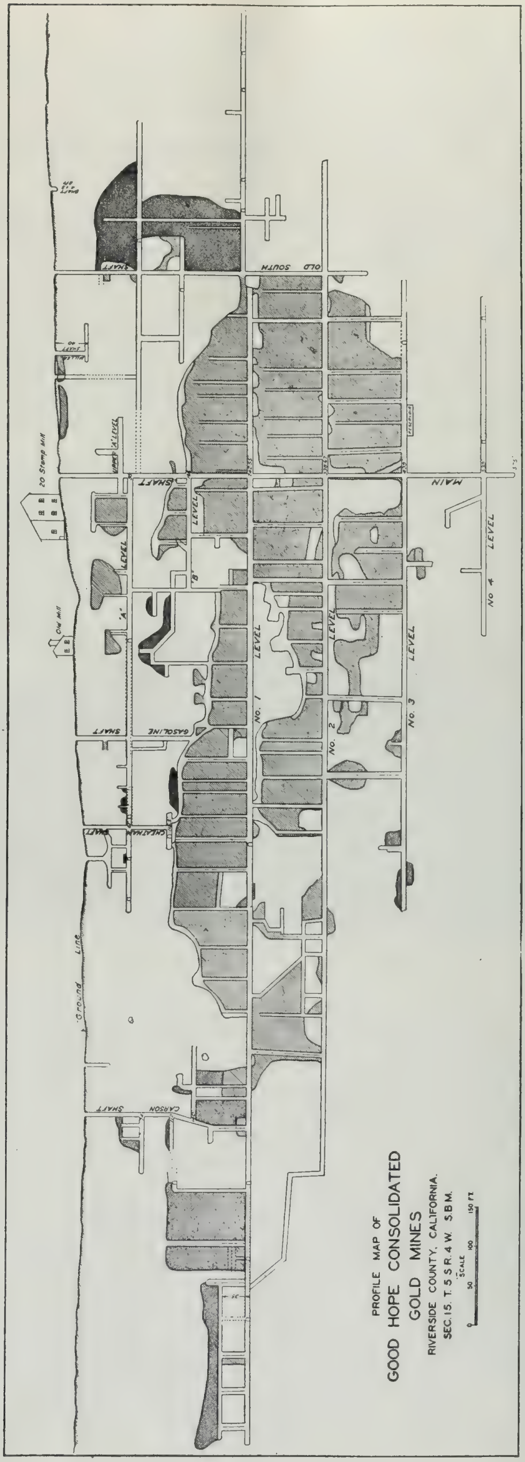
PROFILE MAP OF
GOOD HOPE CONSOLIDATED
GOLD MINES
RIVERSIDE COUNTY, CALIFORNIA.
SEC. 15. T. 5 S. R. 4 W. S.B.M.
SCALE
0
50
100
150 FT
OLD SOUTH SHAFT
MAIN SHAFT
GASOLINE SHAFT
CHEATHAM SHAFT
CARSON SHAFT
UPPER 'A' LEVEL
'A' LEVEL
'B' LEVEL
NO. 1 LEVEL
NO. 2 LEVEL
NO. 3 LEVEL
NO 4 LEVEL
20 Stamp Mill
Old Mill
Ground Line

FIG. 2.

mile west is the Water vein set of fractures which dip steeply to the east. Practically all of the development work has been on the Good Hope veins. Near the surface there are several veins in the Good Hope system, which, according to old reports, appear to unite in depth, forming an irregular fissure with branching tendencies. These branches appear to go into the foot-wall from the main fracture which contains the Good Hope vein. At times the fissure is poorly defined and in other places it is accompanied by a heavy clay gouge and the quartz is fractured, indicating long continued movement. The fissure may be called a double fracture, quartz appearing on each hanging and foot-wall and at times, filling the entire fissure. It is accompanied by one of the felsitic dikes mentioned above. The dikes in this series vary in thickness from a few feet to as much as 30 ft. and are on the foot-wall side underground, but showing on the hanging-wall side at the surface.

To the north a basic dike of variable thickness, strike N. 20° E., appears to mark the northern limits of the ore. From this point south, a distance of more than 2000 ft., open-cuts at various places along the surface show that the vein matter carries gold. The stope map published herewith, shows that the vein has been stoped along an almost continuous length of about 1600 ft. The ore is free-milling near the surface, containing some high-grade iron sulphides, with much of the gold content in the sulphides below the 250-ft. level.

Two veins, the Good Hope and Back, have been worked. The Back vein is some 27 ft. in the foot-wall of the Good Hope vein, in the upper levels.

The present operators have unwatered and retimbered the shaft to the 350-ft. level. On the 95-ft. level they have driven 150 ft. south on the Back vein which here is 27 ft. in the foot-wall of the Good Hope vein. It branches from the Good Hope at a depth of 180 ft. On the 166-ft. level 50 ft. south of the shaft, they have driven a cross-cut east 60 ft. For other development see map mentioned above.

A mill has been built on the ground and several thousand tons of the old dump have been treated. The mill is now operating part-time on ore taken out while doing development work.

Milling equipment: No. 2½ Wheeling crusher; 16-in. belt conveyor, 40-ft. centers; 50-ton ore bin, belt feeder; 4 by 8-ft. rod mill; V box hydraulic classifier lined with amalgamating plates; 3 sets 4 by 7-ft. plates, with corduroy cloth launders to drag belt classifier; conditioner; Forrester flotation machine, tails to Diester table. There is also a complete assay laboratory.

Mine equipment consists of 9 by 8-inch air compressor, driven by 40-h.p. motor and 10-h.p. electric hoist.

Fifteen men are employed cleaning out old workings and retimbering.

Operators plan to get to the bottom level (the 550-ft.) where they expect to find ore already exposed in the old drifts.

Bibl: State Mineralogist's Reports VIII, p. 527; IX, p. 151; XI, p. 106; XII, p. 221; XIII, p. 311; XV, pp. 532–533; XXV, p. 480.

Houg Mine, comprising 400 acres, is in Secs. 13 and 24, T. 4 S., R. 5 W., one mile northwest of the Gavilan Mine. Owner, H. M. Harford, Perris, California.

The vein occurs in the granite; strike NW.-SE., dip 40° S. Its width varies from a few inches to 2½ ft. The property was worked in 1884–1886, during which time it is reported to have produced $140,000. The ore was milled in a 5-stamp mill on the San Jacinto River, 14 miles southeast of the mine. The old working consisted of a 300-ft. shaft with four short levels and a shaft approximately 150 ft. deep with an adit level at 100 ft.

The present owner started development in January, 1932. At 100 ft. north of the old shaft, he sunk 78 ft. vertically. He then went down the hill 140 ft. and sunk 60 ft. vertically and 117 ft. on the vein. On the 137-ft. level, drifted 14 ft. north and 14 ft. south; on the 157-ft. level, 70 ft. north and 25 ft. south. Also raised 50 ft. to one of the old levels. At 270 ft. north of the old shaft, sunk 60 ft. vertically and 70 ft. on the vein. At the bottom, drifted south 15 ft. While some spotted values were encountered in this new work, the owner believes that the shoot has raked so far to the north that none of his work has yet tapped it.

The workings were full of water at the time of visit. At present Frank Beatty is working the old dumps through two 1250-lb. stamps, with 4 by 8-ft. plates, operated by 10-h.p. gas engine. Water is obtained from two of the old shafts.

Two men working.

Indian Queen Mine is in the NW. ¼ Sec. 32, T. 4 S., R. 4 W., 4½ miles west of Perris.

Bibl: State Mineralogist's Reports XIII, p. 311; XV, p. 531; XXV, p. 482.

Jumbo Mine is 5 miles west of Perris at an altitude of 2200 ft. A small vein strikes N. 10° W. and drops 80° W. There is a 50-ft. shaft. Idle.

Bibl: State Mineralogist's Reports XIII, p. 312; XV, p. 530; XXV, p. 482.

Leon Mine is on the Briggs Ranch, 14 miles southeast of Perris. Idle.

Bibl: State Mineralogist's Reports XII, p. 223; XIII, p. 312; XXV, p. 483.

Little Maggie, comprising two claims, is in the NW. ¼ Sec. 32, T. 4 S., R. 4 W. Owner, Charles Lanhorn, Box 152, Perris, California.

Vein in granite, strike E.-W., dip 30° S., width 2 to 8 inches. The main shaft is sunk on incline (30°) to 175 ft. East of this shaft, 75 ft. another shaft has been sunk on vein 75 ft. At 75 ft. west of main shaft, another has been sunk on vein 75 ft. Average value of ore is reported to be $32 per ton.

There is a Chilean mill with inside amalgamation and plates, operated by 10-h.p. gas engine; capacity 10 tons per day.

Three men employed.

Bibl: State Mineralogist's Reports XII, p. 223; XIII, p. 312; XXV, p. 483.

Little Pete claim is 4 miles west of Perris. There is a small east-west vein which carries arsenical pyrite. Idle.

Bibl: State Mineralogist's Reports XIII, p. 311; XV, p. 531; XXV, p. 483.

Lucky Boy (*Walker*) claim is on the Walker Ranch, two miles south of Menifee. Idle.

Bibl: State Mineralogist's Reports XI, p. 385; XII, p. 223; XIII, p. 312; XV, p. 534; XXV, p. 484.

Lucky Strike (*Ophir*), comprising 4 claims, is on the east side of highway, midway between Perris and Elsinore. Owners, R. S. Fisher and R. L. Reade, Elsinore, California.

Country rock is granitic. Two veins on the property, strike E.-W.; dip 45° and 35° S. These two veins intersect on the dip on the 50-ft. level. The more steeply dipping vein carries free gold. The values in the other vein are higher in silver and mineralization consists of marcasite, pyrite and arsenopyrite. On the 50-ft. level, the vein is from 2 to 24 inches wide, averaging about 10 inches. The ore-shoot on this level is about 85 ft. long.

Developed by 150-ft. shaft, sunk on 45° incline. On 150-ft. level, drift 150 ft. north; on 50-ft. level, drift 100 ft. north. Lower level under water at time of visit. Reported to show 30 inches of sulphide ore, carrying 25 oz. of silver and $8 in gold.

Equipment consists of 9-h.p. gasoline hoist. Mill equipment includes 6- by 8-inch jaw crusher; 3-ft. hammer mill in closed circuit, with Aikens classifier and Wilfley table, operated by 30-h.p. gasoline engine. Four men are employed.

Bibl: State Mineralogist's Reports XIII, p. 313; XV, p. 532; XXV, p. 486.

Mammoth Mine is in Sec. 8, T. 6 S., R. 3 W., S. B. M. Last known owner, A. A. Adair, Riverside, California. A vein in the granodiorite, reported to average 7 ft. in width, strikes NE. and dips 15° NW. Was developed by a shaft 200 ft. on the incline. Idle.

Bibl: State Mineralogist's Reports XIII, p. 312; XV, p. 534; XXV, p. 484.

Menifee Mine is about 8 miles south of Perris. Owner, Tom Chaffin, at the mine. The vein occurs between a diorite hanging-wall and a thin belt of chloritic schist on the foot-wall. Was developed by 4 shallow shafts 30, 55, 100 and 125 ft. Ore is said to have milled about $15 per ton. Property was formerly equipped with a steam hoist and 5-stamp mill. Idle.

Bibl: State Mineralogist's Reports XI, p. 385; XIII, p. 312; XV, p. 533; XXV, p. 484.

Missing Link (*Virginia-Shay*) is 6 miles west of Perris in the NE. $\frac{1}{4}$ Sec. 32, T. 4 S., R. 4 W., S. B. M. Last known owner, Hugh Duff, 626 Wesley Roberts Bldg., Los Angeles.

Bibl: State Mineralogist's Reports VIII, p. 526; XI, p. 385; XII, p. 225; XIII, p. 313; XV, p. 532; XXV, p. 485.

Old Dominion Mine is in Sec. 7, T. 6 S., R. 5 W., in Long Canyon, 6 miles west of Elsinore. Elevation about 3500 ft. Owners, Mrs. M. A. Gardner and H. O. Langstaff, Elsinore, California. Under lease, with option to purchase, to R. L. Reade, Elsinore, California.

The vein has a N.-S. strike, dipping 70° W. The walls are siliceous slate. Where observed on surface, the vein appeared to have a width of from 3 to 6 ft. Present lessees claim that it averages 12 ft. wide in the old workings which they unwatered but allowed to fill up again. Visible minerals consist of pyrrhotite, pyrite and a little galena. Lessees claim that it carries values in gold, silver, lead, nickel and tin.

Development consists of a vertical shaft about 60 ft. deep which connects with a drift from a cross-cut driven into the hill from a point 50 ft. below the shaft and about 75 ft. north of it. An incline shaft reported to be 90 ft. deep was sunk at a point 30 ft. south of the vertical shaft. These workings are now under water. Idle.

Bibl: State Mineralogist's Reports XV, p. 532; XXV, p. 486.

Perris Mine is 5 miles west of Perris. Last known owner, W. F. Dray, Forestville, California. Idle.

Bibl: State Mineralogist's Reports XIII, p. 313; XV, p. 531; XXV, p. 486.

Ragged Top Group of claims is in the NW. ¼ Sec. 18, T. 6 S., R. 3 W., S. B. M., in Cottonwood Canyon, 3 miles east of Elsinore. Owner, Peter Swanson, 1117 South Bronson, Los Angeles. Two short tunnels, 50 and 60 ft., respectively, were driven on stringers in the granite. Idle.

Bibl: State Mineralogist's Report XXV, p. 486.

Santa Fe Mine southwest of the Santa Rosa, is owned by R. Woods and Son, of Auburndale, California. This old property was once a small producer, having been equipped with a 5-stamp mill. Idle.

Bibl: State Mineralogist's Reports XII, p. 224; XIII, p. 314; XV, p. 530; XXV, p. 487.

Santa Rosa Mine (*Mina Rosalia*). It is in the NW. ¼ Sec. 31, T. 4 S., R. 4. W., S. B. M. Owners, Hook Bros., Perris, California. This is an old mine, now filled with water. A 3-ft. vein was worked to a depth of 200 ft., with some production. It was once equipped with a 20-stamp mill. Idle.

Bibl: State Mineralogist's Reports VIII, p. 526; XI, p. 385; XII, p. 225; XIII, p. 314; XV, p. 529; XXV, p. 487.

Stanford Mine is 5 miles southwest of Perris. Owner, Mark Herrin, Riverside, California. Developed by 125-ft. shaft, with a cross-cut intersecting the shaft at 70 ft. Formerly equipped with a 5-stamp mill. Idle.

Bibl: State Mineralogist's Reports XII, p. 225; XIII, p. 314; XV, p. 532; XXV, p. 487.

Steele Mine (*El Plomo or Victor*) comprising 8 claims, is in Sec. 32, T. 4 S., R. 4 W., in the Pinacate mining district. Owners, Calvert and Fultz.

The principal country rock is granitic. The long tunnel, however, is partially in the metamorphics of this area. The walls of the vein are granitic, probably quartz-diorite. The vein strikes N.-S. and dips 30 to 35° W. It varies in width from 2 inches to nearly 3 ft. Mineralization consists of free gold and galena which is frequently rich in silver.

Development consists of a 1200-ft. tunnel which intersects a shaft at the 100-ft. level. This shaft was sunk 200 ft. on 30° inclination. The first 400 ft. of the tunnel is a cross-cut. The greater part of this work was done in the eighties. Equipment consists of one-stamp mill. Two men working.

Bibl: State Mineralogist's Reports VIII, p. 527; XI, p. 384; XII, p. 225; XIII, p. 314; XXV, p. 489.

MANGANESE

Some deposits of manganese, from which there has been no production, have long been known to exist in Sec. 23 and 24, T. 5 S., R. 4 W., 6 miles northeast of Elsinore. It is probable that the deposits are too low-grade to meet the market requirements.

Bibl: State Mineralogist's Reports XV, p. 546; XXV, p. 493; Bull. 76, p. 58.

TIN

The Temescal tin deposit was discovered about 1853 and in 1860 a company was formed to work the mine. The outbreak of the Civil War in 1861 caused operations to be suspended and nothing further was done until about 1868.

The San Jacinto Tin Mining Company was organized January 2, 1868. The company acquired the Rancho Sobrante de San Jacinto, a Spanish grant, comprising 49,000 acres of land. In 1868 work was resumed on the Cajalco * Mine. The deposit was acquired and worked by an English syndicate from 1890 to 1892. During this period 10,000 tons of ore was extracted from the Cajalco Mine and is said to have averaged 4 per cent tin oxide.

The production in 1891 was 125,289 pounds of tin, valued at $27,564. In 1892 the production was 126,000 pounds, valued at $32,400; the total production being 251,289 pounds, valued at $59,964.

Geological Features.

The area where the tin ore occurs is located 5 miles south of Arlington on the western portion of the Rancho el Sobrante de San Jacinto. The tin ore is found in the tourmaline veins at Cajalco Hill and to a point south about two miles. There is a semicircular area of granite over two miles in diameter, surrounded on the northwest and south by porphyry and adjoining on the east a great body of granitic rocks. Cutting through the granite in a northeast and southwest direction are black tourmaline veins which form the gangue of the tin ore, when it is present. There are two varieties of tin ore: The yellow, occurring in thin layers in a non-crystalline form, and the brown, in granular form in the massive specimens, or in small, clear, reddish-brown crystals lining cavities. The occurrence of tin is also found in tourmaline veins

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* "Cajalco" is correct. Spelling in mine list on map (Plate VIII) is incorrect.

that occur in the granite in the vicinity of Elsinore and Perris. The American Tin Corporation acquired the Temescal Tin Mine and other properties on the Rancho el Sobrante de San Jacinto in the early part of 1927 and has spent a large amount of money in the exploration of the different tourmaline veins on the property.

Mines.

Black Rock Tin Deposit. It comprises 400 acres, located in Secs. 18 and 19, T. 4 S., R. 5 W., S. B. M., two miles southeast of Cajalco Hill on the Rancho el Sobrante de San Jacinto, 7 miles south of Arlington. Last known owner, Black Rock Tin Syndicate; P. H. Gorman, president; G. H. Bryant, vice president and general manager.

Twelve parallel tourmaline veins occur in the granite on this property. The general course of these veins is southeast and they dip 60° to the southeast. The widths vary from 4 to 30 ft. It is said that samples from the outcrops show traces of tin. Some of the vein outcrops are stained with copper oxides.

Development consists of incline shaft sunk to a depth of 125 ft. Formerly the property was equipped with a Chicago pneumatic compressor and a Sullivan trigger hoist. Idle.

Bibl: State Mineralogist's Report XXV, pp. 495–496.

Chief of the Hills Tin Group. This property which is owned by J. M. Mack, Clay L. Berry and Mary Briner, all of Elsinore, California, is located in Sec. 4, T. 6 S., R. 4 W., S. B. M., on the top of a mountain, two miles northeast of Elsinore. Elevation 1900 ft. It comprises 5 claims located in December, 1926.

A belt of slate, schist and felsites having an approximate width of 2000 ft., forms a lens, 4000 ft. long in the granite. The rocks in this belt strike N. 30° W., and dip at an angle of 80° to the east. In this series there are five principal vein dikes having the same strike and dip as the enclosing rocks. These dikes which consist of fine-grained granite have been replaced in part by minutely crystalline tourmaline and quartz. At these points tin has been reported as occurring in amounts varying from 0.30 per cent to 2.21 per cent. The only form observed was the reddish-brown crystals, lining cavities in the tourmaline. On one of these vein dikes, a shaft has been sunk to a depth of one hundred feet. At the bottom, it is reported that a crosscut has been driven 20 ft. to the east and 10 ft. to the west of the shaft. The west cross-cut, according to reports, was driven in material which assayed from 0.31 per cent to 1.22 per cent tin. Idle.

Holmes Ranch Tin Deposit. It comprises 560 acres, located in Sec. 12, T. 4 S., R. 6 W., S. B. M., 1½ miles southeast of Cajalco Hill and 5 miles south of Arlington. Elevation 1300 ft. Owner, Lawrence Holmes, Arlington, California.

Here a tourmaline vein, 6 to 15 ft. wide, can be traced along the outcrop for a considerable distance. Traces of tin (up to 0.30 per cent) are said to exist in samples taken from this outcrop. No development work has been done.

Bibl: State Mineralogist's Report XXV, p. 496.

Moore Tin Deposit. It comprises 600 acres in Sec. 13, 14, 23 and 24, T. 4 S., R. 6 W., S. B. M., about two miles southeast of Cajalco Hill and 7 miles south of Arlington. Owner, Robert L. Moon Estate, Riverside, California.

A series of parallel veins of tourmaline occurs in the granite; strike NE.-SW.

Several shallow shafts have been sunk on the various veins. Some samples have shown as high as 2 to 5 per cent copper. Idle.

Bibl: State Mineralogist's Report XXV, pp. 496–497.

South Block Tin Group, consisting of 80 acres, is in Sec. 19, T. 4 S., R. 5 W., S. B. M., 3 miles southeast of Cajalco Hill. Several tourmaline veins here occur in the granite. Widths vary from 6 to 10 ft. Samples from the outcrops are reported to carry from 0.13 to 0.50 per cent tin. Idle.

Bibl: State Mineralogist's Report XXV, p. 497.

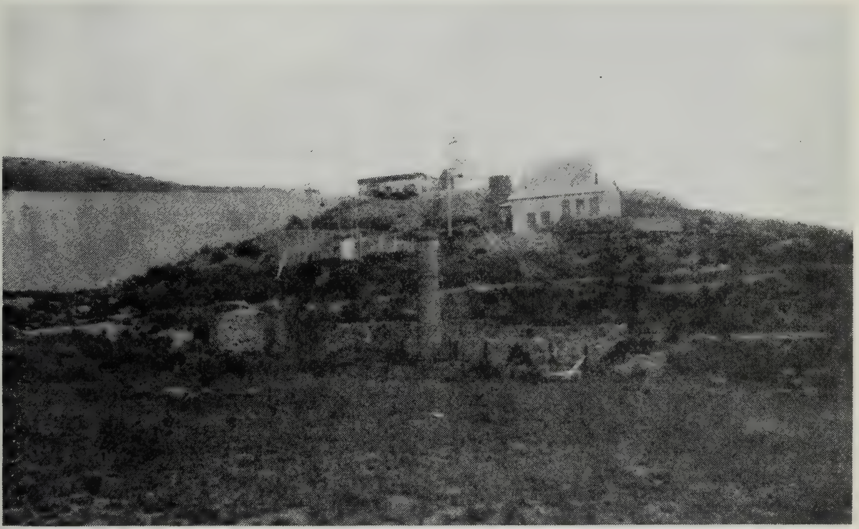


FIG. 3. Temescal Tin Mine, Riverside County.

Temescal Tin Mine. This mine is in the western part of the Rancho el Sobrante de San Jacinto, about 5 miles southeast of Corona. Holdings consist of 870 acres in Sec. 2, 3, 10 and 11, T. 4 S., R. 6 W., S. B. M. Owner, American Tin Corporation; P. H. Gorman, president; G. H. Bryant, vice president and general manager. Last known address, 594 Main Street, Riverside, California.

This company acquired the property in March, 1927, and for three years carried on an extensive development program.

The country rock is a coarse hornblende-biotite granite. Tin occurs as cassiterite in black tourmaline veins, in the coarser-grained granite. There are 65 parallel veins in the granite, 10 of which have been explored. The course of these veins is NE.-SW. and they dip from 55° to 75° NW. The vein matter consists of tourmaline and quartz. The latter mineral occurs in about the same proportion as it does in the normal granite.

A large sum of money was expended in prospecting this ground.

No. 1 shaft was sunk to a depth of 650 ft. with seven levels. On No. 2 vein a shaft 180 ft. deep was sunk and on No. 4 a depth of 175 ft. was reached. These workings together with several thousand feet of lateral work failed to uncover a commercial orebody and the project was abandoned.

Bibl: State Mineralogist's Reports VIII, p. 506; XL, pp. 111–114; XIV, pp. 547–550; XX, p. 46; XXV, pp. 497–499.

NONMETALLICS

The clay deposits of Alberhill are by far the most important deposits of this area. In the past some feldspar, granite and silica have been shipped to Los Angeles.

ASBESTOS

Amphibole asbestos occurs in a shear zone in the granitic rocks, two miles southwest of Perris. No development work other than a shallow surface cut has been done here.

Bibl: State Mineralogist's Report XXV, p. 499.

CLAY

The Alberhill-Corona district is one of the three most important clay producing areas in the state. The deposits extend along Temescal Valley for 15 miles. Elsinore is at the southeast end and they terminate at Corona on the northwest. The width of the belt is from one to two miles and its depth, in places, is over 600 ft.

For detailed descriptions of the area and the deposits, reference should be made to Bulletin No. 99 of the California State Mining Bureau, ''The Clay Resources and Ceramic Industry of California,'' by Waldemar F. Dietrich, and to the State Mineralogist's Report XXXI, Jan. 1935, ''Geological Investigation of the Clays of Riverside and Orange Counties, California,'' by J. Clark Sutherland.

Deposits.

Alberhill Coal and Clay Company, Inc., offices 1031 South Broadway, Los Angeles. The company owns 2000 acres of land, in Secs. 15, 22 and 23, T. 5 S., R. 5 W., S. B. M., in Temescal canyon, near Alberhill.

Bibl: State Mineralogist's Reports XV, pp. 559–574; XIX, pp. 185–210; XXV, p. 500; XXI, pp. 51–87; Bull. 38, pp. 221–222; Bull. 99, pp. 163–169.

Emsco Clay Company (Harrington Deposit). The Emsco Company of Los Angeles has under lease from John Harrington, the Harrington Pit, consisting of 80 acres in Sec. 25, T. 4 S., R. 6 W., S. B. M., in Temescal canyon, 10 miles southeast of Corona.

Bibl: State Mineralogist's Reports XV, p. 568; XXV, p. 500; XXXI, p. 71; Bull. 38, p. 223; Bull. 99, p. 171.

Gladding, McBean and Company has a clay deposit at Alberhill, in Secs. 21 and 22, T. 5 S., R. 5 W., S. B. M., adjoining the Alberhill Coal and Clay Company's property on the east. Their holdings comprise 530 acres.

Bibl: State Mineralogist's Reports XXV, p. 500; XXXI, p. 79; Bull 38, p. 223; Bull. 99, pp. 171–174.

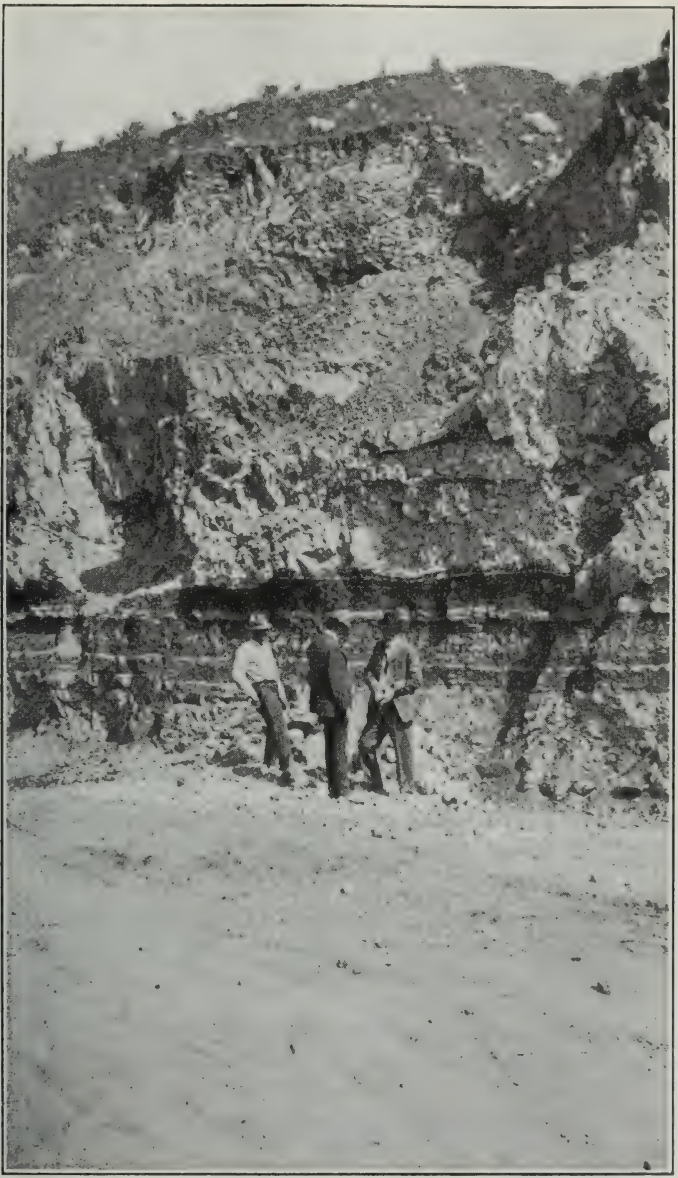


FIG. 4. Exposure of lignite coal and clay beds in pit of Alberhill Coal and Clay Co., at Alberhill.

From State Mineralogist's Report XIX, p. 200.

J. D. Haff, of Elsinore, California, owns a clay property, consisting of 100 acres, in Sec. 22, T. 5 S., R. 5 W., S. B. M., near Alberhill.

Bibl: State Mineralogist's Report XXV, p. 500; Bull. 99, p. 474.

Jones Clay Deposit is in Secs. 17 and 19, T. 4 S., R. 6 W., S. B. M., 7 miles southeast of Corona. Owner, A. E. Jones, Corona, California.

Bibl: State Mineralogist's Report XXV, pp. 500, 501.

Los Angeles Brick Company's property at Alberhill consists of the SE¼ and E½ of the SW¼, of Sec. 21, T. 5 S., R. 5 W., S. B. M., and other property totaling 720 acres. Address of the company is 1078 Mission Road, Los Angeles.

Bibl: State Mineralogist's Report XXV, p. 501; XXXI, p. 70; Bull. 38, p. 223; Bull. 99, pp. 174–176.

Morton Clay Deposit, comprising 80 acres, is 2½ miles northeast of Elsinore. Owner, George H. Morton and son, Elsinore, California.

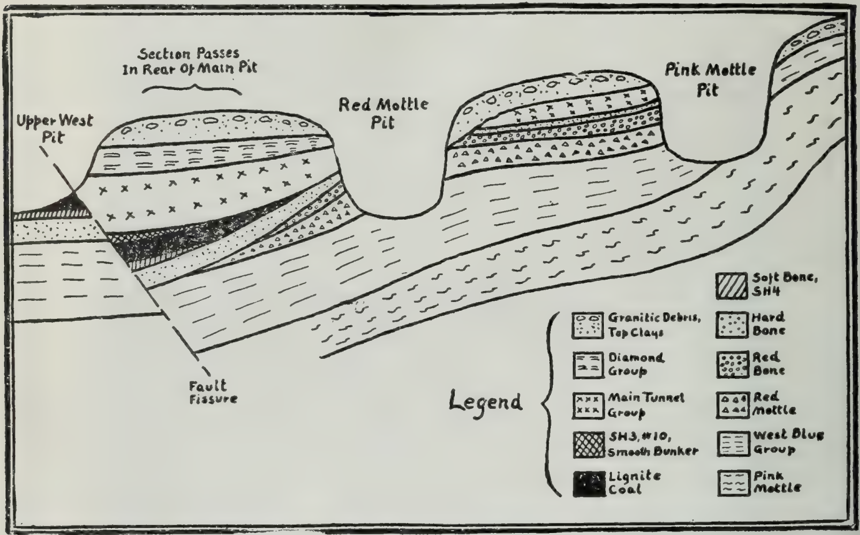

Section Passes In Rear Of Main Pit
Upper West Pit
Red Mottle Pit
Pink Mottle Pit
Fault Fissure
Legend
Granitic Debris, Top Clays
Diamond Group
Main Tunnel Group
SH3, #10, Smooth Bunker
Lignite Coal
Soft Bone, SH4
Hard Bone
Red Bone
Red Mottle
West Blue Group
Pink Mottle

FIG. 5. Diagrammatic section of strata at Alberhill, in a general west-east line.

From State Mineralogist's Report XIX, p. 196.

Pacific Clay Products Company, 1151 South Broadway, Los Angeles, has several deposits in the area between Corona and Elsinore.

The Douglas Pit is an 80-acre tract in Sec. 22, T. 5 S., R. 5 W., S. B. M.

The Hoist Pit is a 40-acre tract in Sec. 26, T. 5 S., R. 5 W., S. B. M.

The McKnight Pit, which has been worked for more than 35 years, is in Secs. 3, 9 and 10, T. 4 S., R. 7 W., S. B. M.

Wildomar Kaolin Deposit, comprising 18 acres, is in T. 7 S., R. 3 W. They also own miscellaneous parcels in the Alberhill district, totaling 428.79 acres.

Bibl: State Mineralogist's Report XXV, p. 502; XXXI, p. 72; Bull. 38, pp. 223–224; Bull. 99, pp. 176–181.

FELDSPAR AND SILICA

Alert Ranch Deposit is in Sec. 26, T. 4 S., R. 2 W., S. B. M., 4 miles south of Lakeview. Owner, Fred Alert, Lakeview, California.

Bibl: State Mineralogist's Report XXVII, pp. 420–421.

Brown Ranch Deposit, consisting of 4 claims is in the SE$\frac{1}{4}$ Sec. 28, T. 4 S., R. 2 W., S. B. M., 5 miles south of Lakeview. Owner, A. M. Brown, Lakeview, California.

Massive outcrops of quartz occur along a pegmatite dike in the granite. Some small segregations of feldspar are found in the quartz.

Bibl: State Mineralogist's Report XXVII, pp. 421–422.

La Borde Deposit is in Sec. 28, T. 4 S., R. 2 W., S. B. M., 4 miles southeast of Nuevo. Some 2000 tons of feldspar was shipped from this deposit by the owners, La Borde Bros., Perris, California.

Bibl: State Mineralogist's Reports XXV, p. 505; XXVII, p. 422.

Machado Deposit, M. Machado, Temecula, California, had under lease deposits of feldspar and silica which are located in Sec. 9, T. 5 S., R. 2 W., S. B. M., 3 miles north of Winchester. Last known owner, W. J. Nierdorf, Winchester, California. It is reported that some 60 cars have been shipped from open cuts on this property.

Bibl: State Mineralogist's Reports XXV, pp. 505–506; XXVII, pp. 423–424.

Morgan Ranch Deposit is in Sec. 28, T. 4 S., R. 2 W., S. B. M., 4 miles south of Lakeview, California. Silica and feldspar occur in lenses along the outcrop of a pegmatite dike in granite. Undeveloped.

Bibl: State Mineralogist's Report XXVII, p. 424.

Patterson Ranch Deposit is in Sec. 29, T. 4 S., R. 2 W., S. B. M., 7 miles south of Lakeview. Owner, J. Neil Patterson, Pasadena, California.

A series of parallel outcrops of silica, containing segregations of feldspar, occurs along pegmatite dikes in granite. Developed by a 50-ft. tunnel and glory hole. Idle.

Bibl: State Mineralogist's Report XXVII, p. 424.

Perris Mining Company formerly worked a deposit of silica and feldspar in Sec. 16, T. 6 S., R. 3 W., 10 miles south of Perris.

Developed by 150-ft. shaft, with levels at 50 and 75 ft. There was a mill on the property. It has been idle for some years.

Bibl: State Mineralogist's Report XXVII, pp. 424–425.

Tully Deposit is in Sec. 32, T. 4 S., R. 2 W., S. B. M., 3 miles south of Lakeview. Owner, W. M. Tully, Nuevo, California.

Large boulders of feldspar occur in a pegmatite dike in granite. The deposits are very irregular and appear to lie almost flat. The largest lens yielded about 2500 tons. Idle.

Bibl: State Mineralogist's Reports XXV, p. 507; XXVII, p. 425.

Weir Ranch Deposit is in Sec. 29, T. 4 S., R. 2 W., S. B. M., 4 miles south of Lakeview.

Small segregations of feldspar occur in massive silica outcrops along a series of parallel pegmatite dikes in granite. The occurrences appear to be too limited in extent to be of commercial value.

Bibl. State Mineralogist's Report XXVII, p. 426.

OIL FIELD DEVELOPMENT OPERATIONS

R. D. Bush, State Oil and Gas Supervisor

From June 30, 1935, to and including September 28, 1935, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
FRESNO COUNTY:					
Russell Giffen & F. A. Yearout	14	20 S.	14 E.	May 1	Coalinga
Pilot Oil Co.	12	20 S.	14 E.	11	Coalinga
John L. Etheridge	27	21 S.	17 E.	Iowa 1	Kettleman North Dome
Kettleman North Dome Assoc.	20	21 S.	17 E.	6	Kettleman North Dome
Kettleman North Dome Assoc.	28	21 S.	17 E.	21	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	58	Kettleman North Dome
Standard Oil Co.	27	21 S.	17 E.	2	Kettleman North Dome
Standard Oil Co.	29	21 S.	17 E.	23	Kettleman North Dome
Standard Oil Co.	29	21 S.	17 E.	76	Kettleman North Dome
KERN COUNTY:					
Continental Oil Co.	36	27 S.	20 E.	Result 6	Belridge
Standard Oil Co.	36	27 S.	20 E.	McPhail 3	Belridge
Arlington Properties Co., Ltd.	6	28 S.	23 E.	Arlington 12-6	Buttonwillow Gas
Fullerton Oil Co.	25	27 S.	23 E.	37	Buttonwillow Gas
Fullerton Oil Co.	26	27 S.	23 E.	32	Buttonwillow Gas
Standard Oil Co.	30	27 S.	24 E.	K. C. L. 7 1	Buttonwillow Gas
The Texas Co.	6	28 S.	23 E.	Sears 1	Buttonwillow Gas
The Texas Co.	8	28 S.	23 E.	Whiting 1	Buttonwillow Gas
Bauer Oil Co.	21	30 S.	29 E.	Bauer 1	Edison
General Petroleum Corp.	14	30 S.	29 E.	Leddy-Nichols 2	Edison
General Petroleum Corp.	24	30 S.	29 E.	Knapp 3	Edison
General Petroleum Corp.	24	30 S.	29 E.	Knapp 4	Edison
A. T. Jergins Trust	13	30 S.	29 E.	Fee 13 6	Edison
A. T. Jergins Trust	13	30 S.	29 E.	Fee 13 7	Edison
A. T. Jergins Trust	13	30 S.	29 E.	Fee 13 8	Edison
A. T. Jergins Trust	13	30 S.	29 E.	McCowan 13 7	Edison
A. T. Jergins Trust	24	30 S.	29 E.	Ross 2	Edison
Monterey Exploration Co.	14	30 S.	29 E.	Citizens 4	Edison
O. & H. Oil Co.	32	30 S.	30 E.	O & H 1A	Edison
A. J. Rogers and H. E. Osborne	19	30 S.	30 E.	Navy 1	Edison
Shell Oil Co.	16	30 S.	29 E.	Cauley 2	Edison
Union Oil Co.	13	30 S.	29 E.	Brockman 1	Edison
Union Oil Co.	14	30 S.	29 E.	Dougherty 2	Edison
S. and G. Oil Co.	26	29 S.	27 E.	Gladys Nickel 1	Fruitvale
Western Gulf Oil Co.	21	29 S.	27 E.	Livezey 1	Fruitvale
Western Gulf Oil Co.	21	29 S.	27 E.	Wear 1	Fruitvale
Western Gulf Oil Co.	27	29 S.	27 E.	Brackenbury 1	Fruitvale
Western Gulf Oil Co.	27	29 S.	27 E.	Sawyer & Reed 1	Fruitvale
Associated Oil Co.	23	28 S.	27 E.	42	Kern River
Bishop Oil Co.	26	28 S.	27 E.	McDonald 6	Kern River
C. C. M. O. Co.	23	28 S.	27 E.	45	Kern River
C. C. M. O. Co.	23	28 S.	27 E.	46	Kern River
C. C. M. O. Co.	23	28 S.	27 E.	47	Kern River
C. C. M. O. Co.	23	28 S.	27 E.	48	Kern River
The Kern River Oilfields of Calif., Ltd.	25	28 S.	27 E.	25-5	Kern River
National Oil Co.	11	28 S.	27 E.	Standard 1	Kern River
Republic Petroleum Co., Ltd.	24	28 S.	27 E.	Strassburger 3	Kern River
Republic Petroleum Co., Ltd.	24	28 S.	27 E.	Strassburger 4	Kern River
Republic Petroleum Co., Ltd.	24	28 S.	27 E.	Strassburger 5	Kern River
Raldo Exploration Co.	22	29 S.	21 E.	Douglas 2	McKittrick
Welport Oil Co.	26	29 S.	21 E.	12	McKittrick
California Commercial Drilling Co.	26	32 S.	23 E.	9	Midway
Honolulu Oil Corp., Ltd.	12	32 S.	24 E.	2	Midway
Honolulu Oil Corp., Ltd.	12	32 S.	24 E.	5	Midway
Honolulu Oil Corp., Ltd.	14	32 S.	24 E.	25	Midway
Standard Oil Co.	3	32 S.	24 E.	30	Midway
Standard Oil Co.	11	32 S.	24 E.	105	Midway
Standard Oil Co.	15	32 S.	24 E.	121	Midway
Hugh Adams and Fred W. Roberts	35	27 S.	28 E.	Glide 1	Mt. Poso
Baker-Grover Co.	33	27 S.	28 E.	Baker 2	Mt. Poso
John C. Gamba	4	27 S.	28 E.	Gamba 1	Mt. Poso
General Petroleum Corp.	16	27 S.	28 E.	Heisen 49	Mt. Poso
General Petroleum Corp.	21	27 S.	28 E.	Glide 21 3	Mt. Poso
Petroleum Securities Co.	34	27 S.	28 E.	Murdoch 1	Mt. Poso
Shell Oil Co.	4	27 S.	28 E.	Matthew Fee 4	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder-Rall 2	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder-Rall 11	Mt. Poso
The Texas Co.	4	27 S.	28 E.	Alta Vedder 7	Mt. Poso
The Texas Co.	4	27 S.	28 E.	Alta Vedder 8	Mt. Poso
Barnsdall Oil Co.	32	30 S.	29 E.	Morris 5	Mountain View
Gilmore-Snyder Co.	24	30 S.	28 E.	Mullaney 3	Mountain View
Hogan Petroleum Co.	29	30 S.	29 E.	Porter-Day 6	Mountain View
Hogan Petroleum Co.	32	30 S.	29 E.	Foster Comm. 1	Mountain View

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued					
Hogan Petroleum Co.	4	31 S.	29 E.	Symons-C. C. M. O. 2	Mountain View
A. T. Jergins Trust	30	30 S.	29 E.	Wright-Bloemer 4	Mountain View
Mohawk Petroleum Co.	30	30 S.	29 E.	Clendenen 6	Mountain View
Mohawk Petroleum Co.	30	30 S.	29 E.	Hood 7	Mountain View
O'Kane & Brain, Inc.	30	30 S.	29 E.	A. E. Wright & C. W. Bloemer 2	Mountain View
Shell Oil Co.	32	30 S.	29 E.	Bahrenburg 2	Mountain View
Standard Oil Co.	13	30 S.	28 E.	Wilson 1	Mountain View
Standard Oil Co.	23	30 S.	28 E.	Wible 5	Mountain View
Standard Oil Co.	23	30 S.	28 E.	Wible 7	Mountain View
Standard Oil Co.	23	30 S.	28 E.	Wible 8	Mountain View
Standard Oil Co.	24	30 S.	28 E.	Mullaney 1	Mountain View
Standard Oil Co.	24	30 S.	28 E.	Ranton 6	Mountain View
Wood-Callahan Oil Co., Ltd.	25	30 S.	28 E.	Wells 1	Mountain View
Wood-Callahan Oil Co., Ltd.	30	30 S.	29 E.	National Oil 4	Mountain View
Associated Oil Co.	4	28 S.	27 E.	3	Poso Creek
Associated Oil Co.	4	28 S.	27 E.	4	Poso Creek
Associated Oil Co.	4	28 S.	27 E.	5	Poso Creek
Ausbrit Oil Corp.	20	27 S.	27 E.	1	Poso Creek
The Ohio Oil Co.	32	27 S.	27 E.	Midway Premier 6	Poso Creek
The Ohio Oil Co.	32	27 S.	27 E.	Midway Premier 7	Poso Creek
Standard Oil Co.	5	28 S.	27 E.	3	Poso Creek
Standard Oil Co.	5	28 S.	27 E.	4	Poso Creek
E. M. Richardson and J. W. Heaston	5	28 S.	28 E.	1	Round Mountain
Shell Oil Co.	17	28 S.	29 E.	Olcese 1 2	Round Mountain
Shell Oil Co.	19	28 S.	29 E.	Jewett 3 5	Round Mountain
Milham Exploration Co.	24	27 S.	23 E.	Continental 27-24	Semitropic Gas
Alford Oil Co.	25	12 N.	24 W.	1	Sunset
General Petroleum Corp.	35	12 N.	24 W.	Moco 35 110	Sunset
General Petroleum Corp.	35	12 N.	24 W.	Moco 35 243	Sunset
Richfield Oil Co.	36	12 N.	24 W.	Maricopa 10	Sunset
Caliente Oil Co.	31	29 S.	30 E.	1	
Continental Oil Co.	18	28 S.	20 E.	Layman 1	
Fullerton Oil Co.	8	27 S.	23 E.	23	
Fullerton Oil Co.	14	27 S.	23 E.	23	
Fullerton Oil Co.	15	27 S.	23 E.	77	
Fullerton Oil Co.	22	27 S.	23 E.	Barnsdall 32	
Milham Exploration Co.	15	27 S.	23 E.	Continental 26-15	
The Ohio Oil Co.	11	11 N.	22 W.	Kern County Land Co. C-11-49	
The Ohio Oil Co.	31	31 S.	26 E.	Kern County Land Co. A-3	
The Ohio Oil Co.	32	31 S.	26 E.	Kern County Land Co. A-2	
Republic Petroleum Co., Ltd.	20	26 S.	27 E.	Republic-Long 1	
Standard Oil Co.	1	27 S.	22 E.	Thompson 1	
Standard Oil Co.	6	27 S.	23 E.	Gutzler 1	
Standard Oil Co.	8	27 S.	23 E.	Western Gulf 1	
Standard Oil Co.	17	27 S.	23 E.	Williams 1	
Standard Oil Co.	20	27 S.	24 E.	K. C. L. 8 1	
Superior Oil Co.	34	27 S.	24 E.	K. C. L. 2	
United Exploration Co.	23	30 S.	27 E.	Ricomini 1	
John H. Webb	16	26 S.	26 E.	Alta 1	
KINGS COUNTY:					
Kettleman North Dome Assoc.	34	21 S.	17 E.	85	Kettleman North Dome
Standard Oil Co.	1	22 S.	17 E.	67	Kettleman North Dome
Standard Oil Co.	7	22 S.	18 E.	32	Kettleman North Dome
Standard Oil Co.	7	22 S.	18 E.	82	Kettleman North Dome
LOS ANGELES COUNTY:					
Shell Oil Co.	33	3 S.	13 W.	Reyes 77	Dominguez
Shell Oil Co.	34	3 S.	13 W.	Reyes 67	Dominguez
Shell Oil Co.	34	3 S.	13 W.	Reyes 68	Dominguez
Shell Oil Co.	34	3 S.	13 W.	Reyes 70	Dominguez
Shell Oil Co.	34	3 S.	13 W.	Reyes 71	Dominguez
Shell Oil Co.	34	3 S.	13 W.	Reyes 80	Dominguez
Union Oil Co.	33	3 S.	13 W.	Hellman 39	Dominguez
Union Oil Co.	33	3 S.	13 W.	Hellman 41	Dominguez
Standard Oil Co.	8	2 S.	14 W.	Cone 17	Inglewood
Standard Oil Co.	8	2 S.	14 W.	L. A. Investment Lease 77	Inglewood
Standard Oil Co.	8	2 S.	14 W.	L. A. Investment Lease 77	Inglewood
Standard Oil Co.	8	2 S.	14 W.	Rubel 19	Inglewood
Standard Oil Co.	8	2 S.	14 W.	Rubel 20	Inglewood
Standard Oil Co.	8	2 S.	14 W.	Rubel 21	Inglewood
Sunbar Petroleum Corp.	16	2 S.	14 W.	Baldwin Hills 1	Inglewood
Abrams and Daly Oil Co., Inc.	30	4 S.	12 W.	Abrams and Daly 1	Long Beach
Angel-Denny Corp.	30	4 S.	12 W.	1	Long Beach
Bay Oil Co.	29	4 S.	12 W.	Bay Oil 1	Long Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well. No.	Field
LOS ANGELES COUNTY—Continued					
Benwood Oil Co.	24	4 S.	13 W.	Benwood 1	Long Beach
Big 4 Oil Co.	19	4 S.	12 W.	1	Long Beach
Boswell Petroleum Co.	19	4 S.	12 W.	Richfield Alsop 2	Long Beach
O. O. Boyd	30	4 S.	12 W.	1	Long Beach
Britannic Oil Corp.	29	4 S.	12 W.	1	Long Beach
Chief Oil Co.	29	4 S.	12 W.	Chief 4	Long Beach
Continental Properties, Inc.	29	4 S.	12 W.	Bixby 1	Long Beach
Virginia Dare Oil Co.	30	4 S.	12 W.	1	Long Beach
Derrick Equipment Co.	29	4 S.	12 W.	Dereco 1	Long Beach
Eskagee Oil Co.	29	4 S.	12 W.	Eskagee 1	Long Beach
Great States Oil Co.	29	4 S.	12 W.	Great States 1	Long Beach
H. and G. Oil Co.	30	4 S.	12 W.	1	Long Beach
Harlyn Oil Co.	29	4 S.	12 W.	Painted Hills 3	Long Beach
Hill Petroleum Corp.	29	4 S.	12 W.	1	Long Beach
Hysom and Young	30	4 S.	12 W.	Hysom & Young 1	Long Beach
K. & G. Oil Co., Inc.	30	4 S.	12 W.	Brooks 1	Long Beach
Keystone Western Oil Co.	29	4 S.	12 W.	1	Long Beach
Los Angeles Refining Co.	29	4 S.	12 W.	2	Long Beach
MacGregor Oil Co., Inc.	30	4 S.	12 W.	MacGregor 1	Long Beach
Marlow Oil Co.	19	4 S.	12 W.	Marlow 1	Long Beach
Masco Oil Co.	29	4 S.	12 W.		Long Beach
McBroom Oil Co.	30	4 S.	12 W.	Jeannerett 1	Long Beach
Morton & Elder	29	4 S.	12 W.	Nesa 1	Long Beach
H. W. Nall	30	4 S.	12 W.	Nall 1	Long Beach
Neva Oil Co.	29	4 S.	12 W.	Neva 1	Long Beach
Oceanic Oil Co.	29	4 S.	12 W.	Oceanic 4	Long Beach
Petcamp Oil Co.	30	4 S.	12 W.	Petcamp 1	Long Beach
Petroleum Securities Co.	29	4 S.	12 W.	Wilson 2	Long Beach
Pierce Petroleum Corp.	30	4 S.	12 W.	Lightburn Comm. 1	Long Beach
Progress Oil Co.	19	4 S.	12 W.	Progress 1	Long Beach
S. & W. Oil Co.	30	4 S.	12 W.	S. & W. 1	Long Beach
San Lorenzo Oil Corp.	29	4 S.	12 W.	Painted Hills 1	Long Beach
Shell Oil Co.	29	4 S.	12 W.	Alamitos 42	Long Beach
Shell Oil Co.	29	4 S.	12 W.	Babb & Tucker 8	Long Beach
Signal City Syn.	30	4 S.	12 W.	Signal City 1	Long Beach
Skepco Oil Corp.	29	4 S.	12 W.	Skepco 1	Long Beach
Union Oil Co.	30	4 S.	12 W.	Long Beach Comm. 27	Long Beach
C. K. Vanoy	24	4 S.	13 W.	1	Long Beach
Venton Oil Co.	29	4 S.	12 W.	Republic 1	Long Beach
Standard Oil Co.	1	2 S.	12 W.	Baldwin 78	Montebello
The Texas Co.	6	2 S.	11 W.	Baldwin 13	Montebello
N. M. Fraser	6	3 N.	16 W.	Gerard 1	Newhall
Saratoga Oil Co.	17	3 N.	16 W.	7	Newhall
Lunor Incorporated	27	2 S.	15 W.	1	Playa del Rey
F. W. Nowell	26	2 S.	15 W.	Nowell 1	Playa del Rey
Treasure Oil Co., Ltd.	27	2 S.	15 W.	8	Playa del Rey
Union Oil Co.	27	2 S.	15 W.	Del Rey 11	Playa del Rey
Union Oil Co.	27	2 S.	15 W.	King Vidor 13	Playa del Rey
Union Oil Co.	31	2 S.	11 W.	Bell 86	Santa Fe Springs
Union Oil Co.	31	2 S.	11 W.	Bell 90	Santa Fe Springs
Union Oil Co.	31	2 S.	11 W.	Bell 91	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Alexander 26	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Alexander 27	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Alexander 28	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 83	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 87	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 88	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 89	Santa Fe Springs
Continental Oil Co.	11	5 S.	12 W.	Bixby 37	Seal Beach
Pioneer Holding Co., Inc.	33	3 S.	14 W.	Pioneer 1	Torrence
C. W. Partridge & Wm. Chambers	22	2 S.	11 W.	6	Whittier
Eyer Petroleum Corp.	20	4 S.	13 W.	1	
Hillman-Long, Inc.	28	1 S.	11 W.	Mullholand 1	
Larco Oil Co.	12	3 S.	15 W.	Van 1	
North American Oil Consolidated	30	1 S.	10 W.	Smith 3-1	
Oil & Gas Associates, Inc.	9	2 S.	11 W.	1	
West American Oil Co.	20	2 S.	12 W.	Bandini 2	
Wilshire Annex Oil Co.	11	2 S.	11 W.	Baldwin C 1	
Wilshire Oil Co., Inc.	4	2 S.	11 W.	Pellissier 1	
MONTEREY COUNTY:					
J. C. Creagmile & J. T. Stewart	28	23 S.	12 E.	Detoy 2	
ORANGE COUNTY:					
Standard Oil Co.	17	3 S.	10 W.	Murphy-Coyote 125	Coyote Hills
Duke-Gates Petroleum Co.	2	6 S.	11 W.	1	Huntington Beach
Kel-Rich Oil Co., Inc.	35	5 S.	11 W.	Adele 3	Huntington Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
ORANGE COUNTY—Continued					
Marview Oil Co.	2	6 S.	11 W.		Huntington Beach
Southern Beach Oil Co.	2	6 S.	11 W.	1	Huntington Beach
Continental Oil Co.	14	5 S.	10 W.	Santa Ana Comm. 1	
SAN BERNARDINO COUNTY:					
Hillman-Long, Inc.	2	3 S.	8 W.	Pellissier 1	
SAN JOAQUIN COUNTY:					
Amerada Petroleum Corp.	15	2 S.	5 E.	FDL 2	
Amerada Petroleum Corp.	22	2 S.	5 E.	31-22	
SAN LUIS OBISPO COUNTY:					
Birch-Royer Oil Co.	33	31 S.	13 E.	B. E. Patchett 1	Arroyo Grande
J. D. Martin	5	32 S.	13 E.	Pricco A 4	Arroyo Grande
SANTA BARBARA COUNTY:					
Shell Oil Co.	32	5 N.	30 W.	Covarrubias 1 6	Capitan
Shell Oil Co.	32	5 N.	30 W.	Covarrubias 1 7	Capitan
Shell Oil Co.	32	5 N.	30 W.	Covarrubias 1 9	Capitan
Shell Oil Co.	32	5 N.	30 W.	Covarrubias 2 2	Capitan
Signal Oil and Gas Co.	16	4 N.	29 W.	Appleford 98 5	Elwood
Caroline C. Spalding	16	4 N.	29 W.	Blue Goose 93 11	Elwood
Dralock Oil Co.	28	4 N.	27 W.	Beckstead 1	Mesa
M. M. Humphries	20	4 N.	27 W.	Edna Mae 1	
Refugio Oil Co.	31	5 N.	30 W.	Careaga 1	
Santa Barbara Oil and Gas Co.	29	4 N.	25 W.	Bryce 1	
Union Oil Co.	16	10 N.	34 W.	Le Roy 1	
TULARE COUNTY:					
Pacific Exploration Corp.	17	21 S.	27 E.	Castle 1	
Standard Oil Co.	33	24 S.	23 E.	Bolz 1	
VENTURA COUNTY:					
Bankline Oil Co.	3	3 N.	19 W.	Calumet B1	Barsdale
Condor Oil Co.	6	4 N.	19 W.	Condor 1	Sespe
R. E. McClellan	4	4 N.	19 W.	Rehart 1	Sespe
Frans Nelson and Co.	29	5 N.	19 W.	Frans Nelson 1	Sespe
The Texas Co.	29	4 N.	19 W.	Fillmore Unit Plan 2-1	Sespe
Topa Topa Oil Co.	33	5 N.	19 W.	3	Sespe
James S. Hull	2	2 N.	18 W.	Hull 1	Simi
Associated Oil Co.	24	3 N.	23 W.	V. L. & W. 24	Ventura
Associated Oil Co.	25	3 N.	23 W.	V. L. & W. 29	Ventura
Brown and Thomas	33	4 N.	23 W.	27	Ventura
Shell Oil Co.	28	3 N.	23 W.	Gosnell 38	Ventura
Ventura Exploration Co.	31	3 N.	22 W.	Walter Sexton 1	Ventura

SPECIAL ARTICLES

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of the new laws and official regulations and notices affecting the mineral industry.

ADMINISTRATIVE

WALTER W. BRADLEY, State Mineralogist.

Personnel.

There have been no changes of personnel in the Division of Mines to be noted the past three months.

New Publications.

'CALIFORNIA JOURNAL OF MINES AND GEOLOGY.'—both the April and July quarterly chapters are in press, and should be available for distribution soon.

Bulletin No. 111, 'California Mineral Production for 1934' is in press and should be distributed sometime in January. It will also contain tabulations of the total recorded mineral production to the end of 1934 for each county of the state. These tables were last printed in 1928, giving the figures to the end of 1927.

Commercial Mineral Notes (Nos. 148–150 inc.), August-October, respectively. These 'Notes' contain the lists of 'mineral deposits wanted,' and 'mineral deposits for sale,' issued in the form of a mimeographed sheet monthly. It is mailed free to those on the mailing list for 'CALIFORNIA JOURNAL OF MINES AND GEOLOGY.' As an evidence of the interest in mines and mineral resources now showing considerable activity, this mimeographed 'sheet' has had to be expanded to three pages in recent months.

Mail and Files.

The Division of Mines maintains, in addition to its correspondence files and the library, a mine file which includes original reports on the various mines and mineral properties of all kinds in California.

During each quarterly period there are several thousand letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, marketing of refined products and mining law. In addition to this, hundreds of oral questions are answered daily, both at the main office and the district offices, for the many inquirers who come in for personal interviews and to consult the files and library.

MINERALS AND STATISTICS

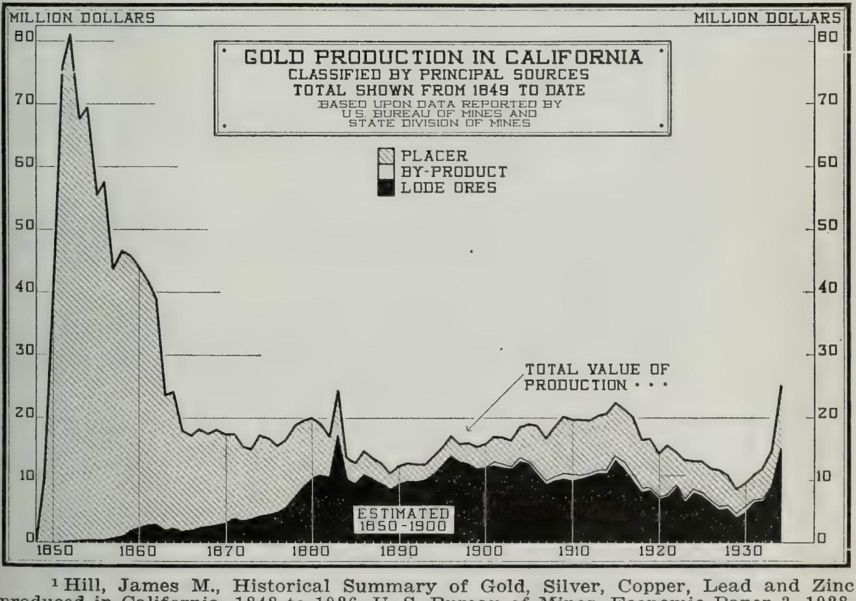
Statistics, Museum, Laboratory

Henry H. Symons, Statistician and Curator.

The complete, detailed annual report on the mineral production of California for 1934, with a directory of producers, will be available, as Bulletin No. 111 of the State Division of Mines. The 1934 mineral output was valued at $237,374,709. See July, 1935, issue of California Journal of Mines and Geology.

SOURCES OF GOLD PRODUCED IN CALIFORNIA FROM 1848 TO 1934

Data on the various methods of placer mining and types of ore from which lode gold was derived were compiled by James M. Hill[1] in 1928, giving the placer and lode values of gold in ten-year periods and from 1900 the annual value by sources as well as lode and placer up to and including 1926. The Division of Mines has compiled these data to include 1934 by taking available information from the annual numbers of U. S. Bureau of Mines Mineral Resources (1927 to 1931) and U. S. Bureau of Mines, Minerals Year Book (1932 to 1935).



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[1] Hill, James M., Historical Summary of Gold, Silver, Copper, Lead and Zinc produced in California, 1848 to 1926, U. S. Bureau of Mines, Economic Paper 3, 1928.

SOURCES OF GOLD PRODUCED IN CALIFORNIA, 1848 TO 1934

Period	Placer					Lode					Total value
	Dredge	Drift	Hydraulic	Surface sluice	Total	Gold and silver ore	Copper ore	Lead ore	Zinc ore	Total	
1848-1850					$51,669,767						[1]$51,669,767
1851-1860					581,561,868					$5,874,362	[2]587,436,230
1861-1870					211,388,439					23,487,604	[3]234,876,043
1871-1880					120,910,077					51,818,604	[4]172,728,681
1881-1890					37,881,328					113,643,986	[5]151,525,314
1891-1900	[6]$426,118				29,416,001					117,664,005	[7]147,080,006
1901	471,762	[8]$1,061,489	[8]$1,698,720	[8]$719,078	3,951,049	$12,499,743	$421,385	$116,867		13,037,995	16,989,044
1902	867,665	[9]889,161	[9]1,256,222	[9]1,234,554	4,247,602	12,295,261	361,951	5,506		12,662,718	16,910,320
1903	1,475,749	905,679	872,812	798,521	4,052,761	[10]11,973,291	[10]272,801	[10]1,800		12,247,892	16,300,653
1904	2,187,038	933,954	1,028,183	836,115	4,985,290	13,136,758	511,108	520		13,648,386	18,633,676
1905	3,276,141	815,240	975,140	825,555	5,892,076	12,772,219	224,650	9,600		13,006,469	18,898,545
1906	5,098,359	605,817	1,054,172	617,577	7,375,925	11,036,018	318,489	1,020	$1,000	11,356,527	18,732,452
1907	5,065,437	563,383	909,011	302,864	6,840,695	9,532,771	344,421	9,504	537	9,887,233	16,727,928
1908	6,536,189	390,545	743,797	560,656	8,231,187	10,050,853	473,092	6,427		10,530,372	18,761,559
1909	7,382,950	739,797	605,608	376,078	9,104,433	10,433,400	691,062	8,975		11,133,437	20,237,870
1910	7,550,254	516,929	635,498	186,114	8,888,795	10,143,780	658,288	24,577		10,826,645	19,715,440
1901-1910	39,911,544	7,421,994	9,779,163	6,457,112	63,569,813	113,874,094	4,277,247	184,796	1,537	118,337,674	181,907,487
1911	7,666,461	479,900	675,486	164,680	8,986,527	10,317,794	427,789	6,798		10,752,381	19,738,908
1912	7,429,955	387,992	689,682	138,034	8,645,663	10,771,759	293,946	1,717	393	11,067,815	19,713,478
1913	8,090,294	192,538	329,300	224,045	8,836,177	11,222,566	320,939	27,276		11,570,781	20,406,958
1914	7,783,394	329,948	702,884	264,623	9,080,849	11,200,323	343,776	28,548		11,572,647	20,653,496
1915	7,796,465	272,955	420,770	118,427	8,608,617	13,315,559	491,940	23,555	2,625	13,833,679	22,442,296
1916	7,769,227	251,297	390,015	165,118	8,575,657	11,876,291	922,876	35,504	413	12,835,084	21,410,741
1917	8,313,527	366,759	267,103	126,641	9,074,030	10,244,720	669,809	98,945		11,013,474	20,087,504
1918	7,431,927	108,420	213,229	85,203	7,838,779	8,287,599	319,701	82,455	419	8,690,174	16,528,953
1919	7,716,919	85,341	184,832	45,984	8,033,076	8,499,014	126,866	36,887	112	8,662,879	16,695,955
1920	6,900,366	62,925	66,233	31,089	7,060,613	7,158,329	38,459	53,642		7,250,430	14,311,043
1911-1920	76,898,535	2,538,075	3,939,534	1,363,844	84,739,988	102,893,954	3,956,101	395,327	3,962	107,249,344	191,989,332
1921	7,756,787	127,411	162,808	107,818	8,154,824	7,502,516	29,747	16,681	1,054	7,549,998	15,704,822
1922	4,999,215	252,626	158,275	89,739	5,499,855	9,010,902	118,632	30,012	10,945	9,170,491	14,670,346
1923	6,065,735	184,771	111,828	160,249	6,522,583	6,645,102	177,129	34,199		6,856,430	13,379,013
1924	4,305,521	98,568	60,195	124,088	4,588,372	8,104,441	436,786	16,442	4,134	8,561,803	13,150,175
1925	4,750,842	66,523	175,345	103,434	5,096,144	7,575,496	342,834	47,083	3,773	7,969,186	13,065,330
1926	4,950,545	111,236	69,139	97,483	5,228,403	6,421,117	230,199	23,966	19,796	6,695,078	11,923,481

1927	5,461,929	141,929	120,832	112,623	5,837,313	5,476,238	342,269	8,259	6,939	5,833,705	11,671,018
1928	4,430,913	153,386	91,512	174,818	4,850,629	5,583,082	345,750	5,854	----------	5,934,686	10,785,315
1929	3,589,259	84,668	59,732	136,948	3,870,607	4,234,056	414,384	7,656	----------	4,656,096	8,526,703
1930	3,451,801	62,615	89,403	151,324	3,755,143	5,200,516	485,239	10,264	----------	5,696,019	9,451,162
1921-1930	49,762,547	1,283,733	1,099,069	1,258,524	53,403,973	65,753,466	2,922,969	200,416	46,641	68,923,492	122,327,365
1931	3,619,355	111,199	62,556	227,636	4,020,746	6,483,662	281,291	28,563	----------	6,793,416	10,814,162
1932	3,903,481	205,880	122,876	533,238	4,765,475	6,936,451	32,275	31,525	----------	7,000,251	11,765,726
1933[11]	5,155,716	434,036	114,890	976,201	6,680,843	9,002,232	----------	----------	----------	9,002,232	15,685,075
1934[12]	6,782,099	454,098	324,397	2,016,574	9,577,168	15,554,116	----------	----------	----------	15,554,116	25,131,284
1931-1934	19,460,651	1,205,213	624,719	3,753,649	25,044,332	37,976,461	313,556	60,088	----------	38,350,015	63,394,247
Grand total	$186,459,395	$12,449,015	$15,442,485	$12,833,129	$1,259,585,186	$320,497,975	$11,156,317	$840,627	$52,140	$645,349,086	$1,904,934,372

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[1] Estimated as 100 per cent from placer mines.

[2] Estimated as 1 per cent from gold-lode mines and 99 per cent from placer mines.

[3] Estimated as 10 per cent from gold-lode mines and 90 per cent from placer mines.

[4] Estimated as 30 per cent from gold-lode mines and 70 per cent from placer mines.

[5] Estimated as 75 per cent from gold-lode mines and 25 per cent from placer mines.

[6] Dredge production first recorded in 1898, $18,887; 1899, $206,302; 1900, $200,929. See U. S. Geological Survey Mineral Resources, Pt. 1, 1914, p. 357, for table to date. Note previous tables gave no production for 1898.

[7] Estimated as 80 per cent from gold-lode mines and 20 per cent from placer mines.

[8] Estimated distribution from information in Annual Report of Director of Mint, 1901, p. 90.

[9] Estimated distribution from information in Annual Report of Director of Mint, 1902, p. 76.

[10] From U. S. Geological Survey tabulation sheets.

[11] Value calculated at an average weighted price of $25.56 a fine ounce; previously $20.6718.

[12] Value calculated at an average weighted price of $34.95 a fine ounce.

MUSEUM

The Museum of the State Division of Mines possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Division of Mines as well as by those who utilize the facilities of the collection.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the State and to San Francisco.

Among specimens received recently and catalogued for the museum are the following:

20628 Iridescent OBSIDIAN from Davis Creek, Modoc County California, donor, Donald G. Wright.

20629 GOLD-SILVER ORE. 4 pieces of typical ore from the SILVER QUEEN vein, 200 FT. LEVEL. Golden Queen Mine, Mojave, Kern County, California, donor, Golden Queen Mining Co.

20630 JEFFERISITE. A hydrated mica (hydrous silicate of magnesium, iron, aluminum), from Fremont County, Colorado, donor, H. L. Lea.

20631 JASPER. From Stone Canyon, Monterey County, California, donor, H. C. Tillman.

20632 DENDRITE. An oxide of manganese, crystals giving fern-like figures on Rhyolite, from Volcano, Amador County, California, donor, Lagomarsino Bros.

20633 DURDENSITE. (Fe_2O_3. $3TeO_2$. $4H_2O$) from Jumbo Mine, Goldfield, Nevada (Exchange).

20634 TENORITE. (CuO) copper oxide, from the lava flow of 1929 eruption of Mt. Vesuvius, Italy (Exchange).

20635 OCTAHEDRITE. (TiO) titanium oxide, yellow crystals with magnetite from Binnenthal, Switzerland.

20636 PYRITE. (Auriferous) iron sulphide, well crystallized in both pentagonal dodecahedrons and cubes from Carson Hill Mine, Melones, Calaveras County, California.

20637 PARADISE JASPER (rough and polished), from 15 miles northwest of Hollister, in Santa Clara County, California, donor, Wilfred C. Eyles.

20638 BRECCIATED JASPER (rough and polished), from Stone Canyon, Monterey County, California, donor, Wilfred C. Eyles.

20639 CHALCEDONY nodule from Bend, Oregon, donor, Wilfred C. Eyles.

20640 SERICITE-SCHIST, a fine-grained Muscovite mica from Mariposa County, California, donor, C. B. Deatsch.

20641 METAMORPHIC FRAGMENTAL STRATIFIED ROCK, possibly recemented volcanic ash resembling Felsite in appearance (polished), from near Volcano Mountain, below Lake Hodges Dam, San Diego County, California, donor, George D. Dodds.

20642 BARITE ($BaSO_4$) from Democrat Mine on Bear River near Alta in Nevada County, donor, Walter W. Bradley.

20643 COAL (from thin seam) with shale, East Portal, Yerba Buena Island Tunnel of Bay Bridge Project, donor, Walter W. Bradley.

20644 SANDSTONE, FRANCISCAN (Cahil), from core, 220 ft. in from West Portal, Yerba Buena Island Tunnel of Bay Bridge Project, donor, Walter W. Bradley.

LABORATORY

FRANK SANBORN, Mineral Technologist

TESTING CONCENTRATES FOR GOLD

The Division of Mines is frequently requested to suggest wet or other tests that can be used in the field for detecting small amounts of gold in an ore, and information about the purple of Cassius, benzidine and other tests for gold is often asked for.

The furnace methods of assaying are the only entirely satisfactory means of detecting small amounts of gold and silver. There is a way, however, of generally revealing the presence of a small amount of gold in concentrates that are obtained in panning. Gold is often locked up in pyrite, galena, cerussite and other minerals, and this gold can not be seen in the concentrates. Such an ore may be tested in the following way:

Pan in the regular way. If any concentrates such as pyrite, galena, etc., are present make them form a ''tail,'' and wash the heaviest of these sulphides into a small beaker. Not more than half a thimble full of ore should be taken for a test, but be sure those sulphides are taken that would normally contain the free gold. If the concentrates obtained for a test are coarse, it is advisable first to dry then pulverize them in order to hasten the action of the acid. Treat the pulverized concentrates with a small amount of dilute nitric acid, one of acid to two or three parts of water—about 15 to 20 cubic centimeters is sufficient. Boil until the sulphides are dissolved, but if necessary add more dilute acid to prevent the solution from becoming too concentrated. The gold, sulphur and any siliceous material should now make up the residue, and the iron or lead should be in solution. Any gold, if present, will probably be in the sulphur, and if it could be seen would likely appear as dark, spongy specks. The solution is now passed through a small filter paper and the residue on the filter washed with water. The filter containing the gold, sulphur and siliceous material is now folded, placed in a small porcelain dish and heated, very gently at first, to dull redness and kept at this heat until the paper is entirely burned. The gold is now annealed, and the burned residue should next be placed in a small dish (butter dish will answer) and rubbed briefly and gently with a small rounded rock to flatten and polish the gold. Add water to the residue—just enough to cover it, and look carefully with a hand lens for the presence of gold.

One should practice the foregoing method by treating concentrates that are known to contain gold locked up in sulphides, but having no visible gold. A small amount of mill concentrates would be desirable for such a test. A sufficient amount of gold-bearing sulphides for testing can often be obtained in the laboratory of the Division of Mines in San Francisco.

LIBRARY

HERBERT A. FRANKE, Librarian.

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the Division of Mines contains over six thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of Federal and State governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, CALIFORNIA JOURNAL OF MINES AND GEOLOGY contains under this heading a list of all books and official reports and bulletins received, with names of publishers or issuing departments.

Files of all the leading technical journals will be found in the library, and county and State maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED

Governmental, National.

U. S. Geological Survey:

Bulletins:

- 859 —Geology of the Santa Rita Mining Area, New Mexico. By Spencer and Paige.
- 862 —The Southern Alaska Range. By S. R. Capps.
- 864B—The Willow Creek Kashwitna District, Alaska. By Capps and Tuck.

Professional Papers:

- 177—The Gold Hill Mining District, Utah. By T. B. Nolan.
- 180—The Minerals of Franklin and Sterling Hill, Sussex Co., N. J. By C. Palache.
- 184—Pre-Cambrian Rocks of the Lake Superior Region, with revised geologic map. By Leith, Lund and Leith.

Library:

- Bibliographical List No. 1—A List of References on the U. S. G. S. and its Work.
- Bibliographical List No. 2—A Suggestive List of References on Federal Emergency Administration of Public Works and its Work.
- Bibliographical List No. 3—A Suggestive List of References on Federal Regulation of the Petroleum Industry.

Water Supply Papers:
657—Water Utilization in the Snake River Basin. By W. G. Hoyt.
741—Part 1—North Atlantic Slope Basins.
742—Part 2—South Atlantic Slope and Eastern Gulf of Mexico Basins.
743—Part 3—Ohio River Basin.
745—Part 5—Hudson Bay and Upper Mississippi River Basins.
746—Part 6—Missouri River Basin.
748—Part 8—Western Gulf of Mexico Basins.
750—Part 10—The Great Basin.
752—Part 12—North Pacific Slope Basins.
754—Part 12—North Pacific Slope Basins.
765—Part 10—The Great Basin.

U. S. Bureau of Mines:
Bulletins:
383—The Free Energies of Vaporization and Vapor Pressures of Inorganic Substances. By K. K. Kelley.
384—Metal Carbonates—Correlations and Applications of Thermodynamic Properties. By Kelley and Anderson.
385—Engineering Factors in the Ventilation of Metal Mines. By G. E. McElroy.
386—Quarry Accidents in the U. S., 1933.

Technical Papers:
561—Mechanical Equipment Used in the Drilling and Production of Oil and Gas Wells in the Oklahoma City Field. By G. Wade.
565—Reduction of Evaporation Losses from Gasoline Bulk-Storage Stations. By Schmidt and Wilhelm.

Report of Investigations:
3275—Progress Report—Metallurgical Division 11. Studies on the Recovery of Gold and Silver by Edmund S. Leaver, M. B. Royer, J. A. Wolf, R. E. Head, B. W. Gandrud, R. E. Evans and F. W. Thackwell.
3276—A Detector for Quantitative Estimation of Low Concentrations of Hydrogen Sulphide. By. J. B. Littlefield, W. P. Yant and L. B. Berger.
3277—The National Safety Competition of 1934. By W. W. Adams and T. D. Lawrence.
3278—Limits of Inflammability of Diethyl Ether and Ethylene in Air and Oxygen. By G. W. Jones, W. P. Yant, W. E. Miller and R. E. Kennedy.
3279—"Base" of a Crude Oil. By E. C. Lane and E. L. Garton.
3280—Coke-Oven Accidents in the United States During the Calendar Year 1934. By W. W. Adams and V. E. Erwin.
3281—Survey of Fuel Consumption at Refineries in 1934. By G. R. Hopkins.
3282—A Procedure for the Removal and Determination of Small Amounts of Benzene in Biological Material. By W. P. Yant, H. H. Schrenk and P. H. Mautz.
3283—Quality of Anthracite as Prepared at Breakers Operated by Members of the Anthracite Institute in 1935.
3284—The Ignition Temperatures of Diethyl Ether and Ethylene in Air and Oxygen. By G. W. Jones, W. P. Yant, W. E. Miller and R. E. Kennedy.
3286—Active List of Permissible Explosives and Blasting Devices Approved Prior to July 31, 1935.
3288—Detailed Statistical Microscopic Analyses of Ore and Mill Products of the Utah Copper Co. By R. E. Head, A. L. Crawford, F. E. Thackwell and Glen Burgener.

Information Circulars:
6841—Procedure for Testing Explosives for Acceptability for use in Forest Service Work. By U. S. Bureau of Mines.
6843—Prospecting for Lode Gold and Locating Claims on the Public Domain. By E. D. Gardner.
6845—List of Devices for Respiratory Protection Approved by the U. S. Bureau of Mines. By W. P. Yant.

6846—Placer-Mining Methods of E. T. Fisher Co., Atlantic City, Wyoming. By Chas. L. Ross and E. D. Gardner.
6847—The Rare Earths. By Alice V. Petar.
6848—Review of Literature on Effects of Breathing Dusts with Special Reference to Silicosis. Part II-B, Chapter 4. Prevention of Dust Diseases (Sections 3–5). By D. Harrington and Sara J. Davenport.
6849—List of Standard Starters Available to Prospective Builders of Permissible Outfits. By H. B. Brunot and M. W. Means.
6850—Petroleum Refineries, Including Cracking Plants, in the United States, January 1, 1935. By G. R. Hopkins and E. W. Cochrane.
6851—Mining Methods and Costs at the Eureka Standard Mine. By E. D. Gardner.
6852—Mining and Milling Tungsten Ores. By Wm. O. Vanderburg.
6854—Induction Prospecting for Shallow Ore Deposits and Small Metallic Objects. By J. W. Joyce.

U. S. Petroleum Administrative Board.
Preliminary Report on a Survey of Crude Petroleum.

U. S. Tariff Commission:
No. 30—Report to the House of Representatives on Crude Petroleum and Its Liquid Refined Products.

Governmental, Foreign.

Alberta Research Council, Edmonton:
Annual Reports.

Argentina Direccion General de Minas y Geologica, Buenos Aires:
Publications.

British Columbia Minister of Mines, Victoria:
Annual Report.

British Museum of Natural History, London:
Publications.

Canada Department of Mines, Ottawa:
Memoir 175—Portland Canal Area, B. C. By G. Hanson.
Memoir 176—Geology of Southern Saskatchewan.
Memoir 177—Lake Ainslie Map-area, U. S. By G. W. H. Norman.
Memoir 178—The Mining Industry of Yukon, 1934. By H. S. Bostock.
Memoir 179—Lode Gold Deposits of Fairview Camp, Camp McKinney, and Vidette Lake Area, and the Dividend-Lakeview Property near Osozoos, B. C. By W. E. Cockfield.
Memoir 180—Mudjatik-Haultain Area, Saskatchewan. By F. J. Alcack.
Memoir 181—Barkerville Gold Belt, Cariboo District, B. C. By G. Hanson.
Bulletin 74—Botanical Investigations in Wood Buffalo Park. By H. M. Raup.
Bulletin 747—Investigations in Ore Dressing and Metallurgy.
Bulletin 754—A Study of Clay Winning and Its Costs in the Provinces of Ontario and Quebec. By J. F. McMahon.
Bulletin 761—Wood Fuel Burning Tests.

Cuerpo de Ingenieros de Minas y Aguas del Peru, Lima:
Bulletins.

Geological Service of Minas Geraes, Bella Horizonte, Brazil:
Publications.

Geological Survey of Great Britain, London:
Memoirs, Geologic Maps, etc.

Geological Survey of Scotland:
Publications.

Great Britain Geological Survey and Museum:
British Regional Geology:
The Welsh Borderland. By R. W. Pocock.
The Grampian Highlands. By H. H. Read.

Northern England. By T. Eastwood.
Scotland—The Tertiary Volcanic District. By J. E. Richey.
The South of Scotland. By J. Pringle.

Instituto Historica e Geographico, Rio de Janeiro:
Publications.

Museo de Historia Natural de Montevideo, Uruguay:
Analas.

New South Wales Department of Mines, Sydney, Australia:
Annual Reports.

New Zealand Geological Survey Branch, Wellington:
Reports.

Nova Scotia Department of Public Works and Mines, Halifax:
Annual Reports.

Ontario Department of Mines, Toronto, Canada:
Publications.

Quebec Bureau of Mines, Quebec:
Publications.

Queensland Department of Mines, Brisbane, Australia:
Annual Reports.

Secretaria de la Economia Nacional, Mexico, D. F.:
Revista Industrial.

South Australian Department of Mines, Adelaide:
Annual Reports, Mining Reviews, etc.

Governmental, State:

Colorado Bureau of Mines, Denver:
Annual Report for the Year, 1934.

Florida Dept. of Conservation, Tallahassee:
Geol. Bull. 13—Ostracoda of the Arca Zone of the Choctawhatchee Miocene of Florida. By H. V. Howe.

Illinois State Geological Survey, Urbana:
Inf. Cir. No. 10—Abstracts of Papers Dealing with Coal.
Inf. Cir. No. 11—Abstracts of Papers Dealing with Clay and Clay Products.
Inf. Cir. No. 12—Abstracts of Papers Dealing with Rock and Rock Products.
P. B. 26—Oil and Gas Development in Illinois in 1934.
Report of the Illinois State Planning Commission, December, 1934.

Iowa Geological Survey, Des Moines:
Vol. XXXVI—Annual Reports, 1930, 1931, 1932, and 1933, with Accompanying Papers.

Louisiana Geological Survey, New Orleans:
Bull. 5—Louisiana Jackson Eocene Ostracoda. By H. V. Howe and J. Chambers.

Michigan College of Mining and Technology, Houghton:
Vol. 8, No. 4—Differentiation in Lavas of the Michigan Keweenuvan.

Societies and Educational Institutions.

Academia de Ciencias y Artes de Barcelona, Spain:
Memoiras.

Academy of Natural Sciences of Philadelphia:
Proceedings.

American Association of Petroleum Geologists, Tulsa, Oklahoma:
Bulletins.

American Geographical Society of New York:
"Geographical Review."

American Journal of Science, New Haven, Conn.

American Philosophical Society, Philadelphia:
Proceedings.

Australian Museum, Sydney.
Records.

California Academy of Sciences, San Francisco:
Proceedings.

Canadian Institute of Mining and Metallurgy, Montreal:
Canadian Mining and Metallurgical Bulletin.

Carnegie Institute of Washington:
Publications.

Cleveland Museum of Natural History, Cleveland, Ohio.
Scientific Publications.

Colorado College Publications, Colorado Springs.

Colorado Scientific Society, Denver.
Proceedings.

Commonwealth Club, San Francisco.
Journals.

Economic Geology, Lancaster, Pa.

Field Museum of Natural History, Chicago:
Geological Series.

Franklin Institute of the State of Pennsylvania, Lancaster, Pa.:
Journals.

Geological Society of America, Columbia University, New York:
Bulletins.

Geographical Society of London:
Abstracts of the Proceedings.

Institution of Mining and Metallurgy, London:
Bulletins, Transactions.

Instituto Geologico de Mexico, Mexico, D. F.
Bulletins.

Journal of Geology, Chicago.

Library of Congress, Washington, D. C.
Monthly Check List of State Publications.

Mineralogical Society of America.
"The American Mineralogist."

Michigan College of Mining and Technology, Houghton.

Mining and Metallurgical Society of America, New York:
Bulletins.

Museu Nacional, Rio de Janeiro:
Boletins.

National Research Council, Washington, D. C.

New York Academy of Sciences, New York:
Annals, etc.

New York State Museum, Albany:
  Publications.

Northwest Scientific Association, Cheney, Wash.
  Northwest Science.

Pennsylvania State College, State College:
  Bulletins.

Philippine Journal of Science, Manila.

Royal Society of South Australia, Adelaide:
  Transactions and Proceedings.

Seismological Society of America, Stanford University.
  Bulletins.

Sierra Club, San Francisco.
  Bulletins.

Society of Economical Paleontologists and Mineralogists, Fort Worth, Texas:
  "Journal of Paleontology."

Southern California Academy of Sciences, Los Angeles.
  Bulletins.

University of California, Department of Geological Sciences, Berkeley.
  Vol. 23, No. 9—Notes on the Variation and Synonymy of Ostrea Idriaensis Gabb. By H. E. Vokes.
  Vol. 23, No. 12—The Genus Velates in the Eocene of California. By H. E. Vokes.

Washington State College of Mines and Geology, Pullman.
  Report No. 5—Revised Report on the Proposed Projects for the Washington State Planning Council.
  Information Circular No. 10—Certain Possible Industries for Washington Utilizing Grand Coulee Power. By A. E. Drucker.
  Information Circular No. 11—Estimated Electric Power Demands for Certain Electrochemical and Metallurgical Industries in the Pacific Northwest over a Period of Thirty Years. By A. E. Drucker.
  Information Circular No. 12—Spectographic Analysis and Some Recent Applications to the Mineral Industry. By J. N. Butler

Books and Pamphlets.

The Gold Mining Industry. By Ford, Bacon & Davis, Inc.
The Mineral Industry during 1934. Edited by G. A. Roush.
Rock Salt for Soil-Stabilized Roads. By International Salt Co., Inc.
Yearbook of the Engineering Profession in B. C., 1935.

Maps.

U. S. Geological Survey Topographic:

Louisiana:
  Slidell Quadrangle.

Oregon:
  Pendleton Quadrangle.

Texas:
  Buena Vista Quadrangle.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
California Journal of Development, San Francisco.

California Mining Journal, Auburn.
California Oil World, Los Angeles.
California Safety News, San Francisco.
Canadian Mining Journal, Gardenvale, Quebec.
Chemical and Metallurgical Engineering, New York City.
Chemical Engineering and Mining Review, Melbourne, Australia.
Commonwealth, San Francisco.
Colorado School of Mines, Golden, Colorado.
Engineering and Mining Journal, New York City.
Fuel Oil, Chicago, Illinois.
Fusion Facts, Whittier, California.
Grizzly Bear, Los Angeles.
Hercules Mixer, Wilmington, Delaware.
Independent Monthly, Tulsa, Oklahoma.
Lubrication, The Texas Co., New York City.
Metals and Alloys, Pittsburgh, Pa.
Mineralogist, Portland, Ore.
Mining Congress Journal, Washington, D. C.
Mining Journal, London.
Mining Journal, Phoenix, Arizona.
Mining and Industrial News, San Francisco.
Mining and Metallurgy, New York City.
Mining Review, Salt Lake City.
Nickel Cast Iron News, New York City.
Northwest Mining, Spokane, Washington.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil, Paint and Drug Reporter, New York City.
Oil Weekly, Houston, Texas.
Pacific Purchaser, San Francisco.
Petroleum World, Los Angeles.
Pit and Quarry, Chicago.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago.
Rocks and Minerals, Peekskill, New York.
Scientific American, New York.
Southwest Builder and Contractor, Los Angeles.
Stabilizer, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York City.
Western Mining News, San Francisco.

Newspapers.

The following papers are received and kept on file in the library:

Amador Dispatch, Jackson, California.
Banner, Sonora, California.
Barstow Printer, Barstow, California.
Bridgeport Chronicle-Union, Bridgeport, California.
Calaveras Californian, Angels Camp, California.
Calaveras Prospect, San Andreas, California.
Daily Commercial News, San Francisco, California.
Del Norte Triplicate, Crescent City, California.
Denver Mining Record, Denver, Colorado.
Inland Oil Index, Casper, Wyoming.
Inyo Independent, Independence, California.
Inyo Register, Bishop, California.
Las Vegas Age, Las Vegas, Nevada.
Livermore Herald, Livermore, California.
Mariposa Gazette, Mariposa, California.
Mercury Register, Oroville, California.
Mojave Miner, Kingman, Arizona.
Morning Union, Grass Valley, California.
Mountain Messenger, Downieville, California.
Needles Nugget, Needles, California.

Nevada City Nugget, Nevada City, California.
Nevada Mining Bulletin, Las Vegas, Nevada.
Oil Marketer, Bayonne, New Jersey.
Placer Herald, Auburn, California.
Plumas Independent, Quincy, California.
Shasta Courier, Redding, California.
Siskiyou News, Yreka, California.
Stockton Record, Stockton, California.
Tehachapi News, Tehachapi, California.
Terra Bella News, Terra Bella, California.
Tuolumne Independent, Sonora, California.
Tuolumne Prospector, Tuolumne, California.
Union Democrat, Sonora, California.
Ventura County News, Ventura, California.
Weekly Trinity Journal, Weaverville, California.
Western Mineral Survey, Salt Lake City, Utah.
Western Sentinel, Etna Mills, California.

PRODUCERS AND CONSUMERS

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by this Division to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of *Mining in California* was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of CALIFORNIA JOURNAL OF MINES AND GEOLOGY, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes,' and sent to those on the mailing list of CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

EMPLOYMENT SERVICE

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

Technical men, or those qualified for supervisory positions, and vacancies of like nature only, are registered, as no attempt will be made to supply common mine and mill labor.

Registration cards for the use of both prospective employers and employees may be obtained upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded. Parties interested should communicate direct with our San Francisco office.

PUBLICATIONS OF THE DIVISION OF MINES

During the past fifty-four years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the State, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have usually been limited, the reports and bulletins mentioned are printed in limited editions many of which are now entirely exhausted.

Copies of such publications are available, however, in the offices of the Division of Mines, in the Ferry Building, San Francisco; State Building, Los Angeles; State Office Building, Sacramento; Redding; and Division of Oil and Gas at Santa Barbara, Santa Paula, Coalinga, Taft, Bakersfield. They may also be found in many public, private and technical libraries in California and other states and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

Money orders should be made payable to Division of Mines.

NOTE.—The Division of Mines frequently receives requests for some of the early Reports and Bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

REPORTS

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----	----
Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	$0.50	$0.10
Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	.50	.10
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----	----
Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	1.00	.15
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	1.00	.20
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:		
Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	.50	.10
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50	.10
Mines and Mineral Resources, Del Norte, Humboldt and Mendocino Counties, 59 pp., paper	.25	.10
Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pp., paper	.50	.10
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.35	.10
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----	----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915: A general Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou and Trinity Counties, 974 pp., 275 illustrations, cloth	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916. Fletcher Hamilton:		
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Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties, 91 pp., paper	.50	.05
Mines and Mineral Resources, El Dorado, Placer, Sacramento and Yuba Counties, 198 pp., paper	.65	.10
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara and Ventura Counties, 183 pp., paper	.65	.10
Mines and Mineral Resources, Los Angeles, Orange and Riverside Counties, 136 pp., paper	.50	.10
Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	.65	.10

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**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917; A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1917–1918, Fletcher Hamilton:		
Mines and Mineral Resources of Nevada County, 270 pp., paper	$0.75	$0.15
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50	.10
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50	.10
Seventeenth Report of the State Mineralogist, 1920, 'Mining in California during 1920,' Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75	.25
Eighteenth Report of the State Mineralogist, 1922, 'Mining in California,' Fletcher Hamilton. Chapters published monthly beginning with January, 1922:		
**January, **February, March, April, May, June, July, August, September, October, **November, December, 1922	.25	.05
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	.25	.05
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy	.25	.05
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange Counties	.25	.05
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura Counties	.25	.05
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego Counties	.25	.10
October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara Counties	.25	.10
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz Counties	.25	.10
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**October, 1926, Mines and Mineral Resources of El Dorado and Inyo Counties, also report on Minaret District, Madera County	----	----
Chapters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1927, Mines and Mineral Resources of Contra Costa County; Santa Catalina Island	.25	.10
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Chapters of Twenty-fourth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1928, Mines and Mineral Resources of Tuolumne County	.25	.05
April, 1928, Mines and Mineral Resources of Mariposa County	.25	.05
July, 1928, Mines and Mineral Resources of Butte and Tehama Counties	.25	.05
October, 1928, Mines and Mineral Resources of Plumas and Madera Counties	.25	.05
Chapters of Twenty-fifth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		

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	Price	Shipping Charges
January, 1929, Mines and Mineral Resources of Lassen, Modoc and Kern Counties; also on Special Placer Machines	$0.25	$0.10
April, 1929, Mines and Mineral Resources of Sierra, Napa, San Francisco and San Mateo Counties	.25	.10
July, 1929, Mines and Mineral Resources of Colusa, Fresno and Lake Counties	.25	.10
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July, 1930, Mines and Mineral Resources of Yuba and San Bernardino Counties; also Commercial Grinding Plants in California	.25	.10
October, 1930, Mines and Mineral Resources of Butte, Kings and Tulare Counties; also Geology of Southwestern Mono County (Preliminary)	.25	.10
Chapters of Twenty-seventh Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1931, Preliminary Report on Economic Geology of the Shasta Quadrangle. Beryllium and Beryl. The New Tariff and Nonmetallic Products. Crystalline Talc. Decorative Effects in Concrete	.25	.10
April, 1931, Stratigraphy of the Kreyenhagen Shale. Diatoms and Silicoflagellates of the Kreyenhagen Shale. Foraminifera of the Kreyenhagen Shale. Geology of Santa Cruz Island	.25	.10
July, 1931. (Yuba, San Bernardino.) Feldspar, Silica, Andalusite and Cyanite Deposits of California. Note on a Deposit of Andalusite in Mono County; its occurrence and chemical importance. Bill creating Trinity and Klamath River Fish and Game District and its effect upon mining	.25	.10
October, 1931. (Alpine.) Geology of the San Jacinto Quadrangle south of San Gorgonio Pass, California. Notes on Mining Activities in Inyo and Mono Counties in July, 1931	.25	.05
Chapters of Twenty-eighth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1932, Economic Mineral Deposits of the San Jacinto Quadrangle. Geology and Physical Properties of Building Stone from Carmel Valley. Contributions to the Study of Sediments. Sediments of Monterey Bay. Sanbornite	.25	.10
**April, 1932. Elementary Placer Mining Methods and Gold Saving Devices. The Pan, Rocker and Sluice Box. Prospecting for Vein Deposits. Bibliography of Placer Mining	----	----
Abstract from April quarterly: Elementary Placer Mining Methods and Gold Saving Devices. Types of Deposits, Simple Equipment. Special Machines. Dry Washing. Black Sand Treatment. Marketing of Products. Placer Mining Areas. Laws. Prospecting for Quartz Veins. Bibliography (mimeographed)	.20	.05
July-October. (Ventura.) Report accompanying Geologic Map of Northern Sierra Nevada. Fossil Plants in Auriferous Gravels of the Sierra Nevada. Glacial and Associated Stream Deposits of the Sierra Nevada. Juarassic and Cretaceous Divisions in the Knoxville-Shasta Succession of California. Geology of a Part of the Panamint Range. Economic Report of a Part of the Panamint Range. Acquiring Mining Claims Through Tax Title. The Biennial Report of State Mineralogist	.50	.15
Chapters of Report XXIX, 1933 (quarterly): titled "California Journal of Mines and Geology," containing the following:		
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of Del Norte and Siskiyou Counties. Applications of Geology to Civil Engineering. The Lakes of California. Discovery of Piedmontite in the Sierra Nevada. Tracing 'Buried River' Channel Deposits by Geomagnetic Methods. Geologic Map of Redding-Weaverville District, showing gold mines and prospects. Geologic Map showing various mines and prospects of part of Del Norte and Siskiyou Counties	$0.80	$0.15
July-October. Gold Resources of Kern County. Limestone Deposits of the San Francisco Region. Limestone Weathering and Plant Associations of the San Francisco Region. Booming. Death Valley National Monument, California. Placer Mining Districts, Senate Bill 480. Navigable Waters, Assembly Bill 1543	.80	.10
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Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free	----
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:		
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**January, **February, **March, **April, **May, **June, **July, **August, **September, **October, **November, **December, 1920	----	----
January, **February, **March, April, **May, **June, **July, August, **September, **October, **November, **December, 1921	Free	----
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**Bulletin No. 10. A Bibliography Relating to the Geology, Paleontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	----	----
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**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations	----	----
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**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet	----	----
**Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, 9 maps	----	----
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**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps	----	----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.	----	----
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**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.	----	----
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**Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp.	----	----
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**Bulletin No. 73. First Annual Report of the State Oil and Gas Supervisor of California, for the Fiscal Year 1915–16, by R. P. McLaughlin. 278 pp., 26 illustrations	----	----
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Bulletin No. 78. Quicksilver Resources of California, with a Section on Metallurgy and Ore-Dressing, by Walter W. Bradley. 1919, 389 pp., 77 photographs and 42 plates (colored and line cuts), cloth	1.50	.35
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†Bulletin No. 80. Foothill Copper Belt of California. (In preparation.)		
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Bulletin No. 83. California Mineral Production for 1917, with County Maps, by Walter W. Bradley. 179 pp., paper	Free	.15
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**Bulletin No. 97. California Mineral Production for 1925, by Walter W. Bradley. 1926, 172 pp., paper	----	----
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**Bulletin No. 100. California Mineral Production for 1926, by Walter W. Bradley. 1927, 174 pp., paper	----	----
**Bulletin No. 101. California Mineral Production for 1927, by Henry H. Symons. 1928, 311 pp., paper	----	----
Bulletin No. 102. California Mineral Production for 1928, by Henry H. Symons. 1929, 210 pp., paper	.25	.10
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Bulletin No. 104. Bibliography of the Geology and Mineral Resources of California, to the end of 1930, by Solon Shedd	2.00	.15
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Bulletin No. 109. California Mineral Production and Directory of Mineral Producers for 1932, by Henry H. Symons. 200 pp., paper	.25	.10
Bulletin No. 110. California Mineral Production and Directory of Mineral Producers for 1933, by Henry H. Symons. 214 pp., paper	.25	.10
Bulletin No. 111. California Mineral Production and Directory of Mineral Producers for 1934, by Henry H. Symons. 334 pp., paper	.50	.15

PRELIMINARY REPORTS

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Map No. 21-A—Portion of District No. 4 showing boundaries of oil fields—Kern County	.75
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Samples (limited to one at one time) of any mineral found in the State may be sent to the Division of Mines for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the State. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

Add to INDEX

Blue Eagle and Black Dike Groups, Siskiyou Co., XXXI, 274-275, 315
Blue Eagle Mine, Kern Co., XXXI, 467
Bridger Mine, Siskiyou Co., XXXI, 315,326
Brite Claim, Kern Co., XXXI, 467
Burns Ranch, Siskiyou Co., asbestos on, XXXI, 264
Burton Claim, Kern Co., XXXI, 467
Cactus Queen Mine, Kern Co., XXXI, 465
East Fork Ledge Mine, Siskiyou Co., XXXI, 317
Easter Mine, Siskiyou Co., XXXI, 317
Eastlick Placer Mine, Siskiyou Co., XXXI, 318
Echo Claim, (see Little Bonanza Group)·
Echo Mine, Kern Co., XXXI, 465
Geography and transportation, San Luis Obispo Co., XXXI, 402-403
Geology, local, of clays, Riverside and Orange counties, XXXI, 62, 75,79, 81.
Geology of portion of Kern Co., XXXI, 465
Geology of San Luis Obispo Co., XXXI, 403
Gold Exploration Co., XXXI, 7
Gold Fields American Development Co., XXXI, 466
Gold Fields of South Africa Mining Corp., XXXI, 466.
Gold Hill Dredging Co., XXXI, 19, 21
Gravel yield at important hydraulic claims in California, XXXI, 354, 355
Gravels, value of, XXXI, 349
Gray Eagle Mine, Kern Co., XXXI, 465
McBrayer Claim, Kern Co., XXXI, 465-466
Mojave Mining District Map, Kern Co., (facing p.) XXXI, 466
Quaternary-Pliocene, XXXI, 113
Queen Esther Mining and Milling Co., XXXI, 466
Silver Bar Mine, Mariposa Co., XXXI, 44
Silver Lane Mine, Mariposa Co., XXXI, 44
Silver Queen Claim, Kern Co., XXXI, 466
Topography of geologic section across the Southern Peninsular Range of California, XXXI, 118
Topography of Kern County, portion of, XXXI, 467
Transportation of streams, XXXI, 182
Trent, Walter E., Claim, Kern Co., XXXI, 467
Trinity River, photograph of hydraulic mining in, XXXI, 153
Tropico Mine, Kern Co., XXXI, 465
Tropico Mining and Milling Co., XXXI, 465
Yellow Butte Mine, Siskiyou Co., XXXI, 273, 333
Yellow Dog Mining Co., Kern Co., XXXI, 465
Yellow Jacket Mine, Siskiyou Co., XXXI, 329

INDEX TO VOLUME XXXI

Page
Abe Lincoln Placer, Siskiyou Co. 314
Abel W. Cook, Placer Mine, Siskiyou Co. 314
Administrative 100, 220, 385, 526
Advance Mine, Siskiyou Co. 314
Aerial photography 147
Age of placers 177
Ager Coal Mine, Siskiyou Co. 270
Alabama-California Mining Co. 17
    Mine, Placer Co. 17
Alamo Mercury Co. 435
Alaska Mine, Sierra Co. 3
Alberhill clay pit, photograph of 56
    Coal and Clay Company, Inc. 518
        , photo of coal and clay beds of 519
    district, photograph of 54
        clays, description of 65
Alcalde claims, Nevada Co. 16
Aldrich Mine, Siskiyou Co. 325
Alert Ranch feldspar and silica deposit, Riverside Co. 520
Algonkian 114
Alhambra Mine, El Dorado Co. 22
Alice Claim (see Little Bonanza Group)
        No. 2 (see Little Bonanza Group)
    Mine, Mariposa Co. 37
        , Riverside Co. 508
Allen, Victor T., cited 165
Allgood & Castell Placer Mine, Siskiyou Co. 314
Alpha Claim, San Luis Obispo Co. 417
Alpine Heights 123, 124, 126
    quartz diorite of the Southern Peninsula Range of California 116, 122, 126
Alviso and Sunshine Claims, San Luis Obispo Co. 414
Amalgamated Mine, Siskiyou Co. 314
Amazon Mine, Siskiyou Co. 314
Amback Mine, Siskiyou Co. 314
Ambrose Mineral Patent (see Collins Ranch Placer)
American Bar Quartz Mine, Placer Co. 17
    Eagle Mine, Placer Co. (see Suckers Revenge)
    Hill Mine, Sierra Co. 4
        Placer, Placer Co. 19
    River Gold Mining Co. 19
        , hydraulic mining on 350
        Tin Corp. 517
Ames copper prospect, Siskiyou Co. 271
    Mine, Siskiyou Co. 314
Analysis of chrome, Seiad Creek deposit, Siskiyou Co. 268
Ancho Mine, Nevada Co. 11
Ancient River terraces of Canyon Creek, photograph of 154
Anderson Mine, Monterey Co. 462
    Placer Mine, Siskiyou Co. 314
Andesite breccia, photograph of 165
    cobble wash, photograph of 165
Anglo-American Mining Corp., Ltd. 443
Antelope Mud Co., San Luis Obispo Co. 416
Antimony in San Luis Obispo Co. 410
Antone Quarry, Siskiyou Co. 337
Apex Claim, Siskiyou Co. 288
Archean 114
Arctic Placer Mine, Sierra Co. 4
Argo Property, Mariposa Co. 46
Arroyo Grande Oil Field, San Luis Obispo Co. 433
    La Cruz chromite deposit (see San Carpojaro Creek deposit)
Arthur Mine, Placer Co. (see Small Hope)
Asbestos in Perris Block, Riverside Co. 518
    San Luis Obispo Co. 410
    Siskiyou Co. 264–265
Ascondry Drift Placer Mine, Siskiyou Co. 314
Asphalt in San Luis Obispo Co. 410
Auburn-Chicago Mining Co. 17
Aumaier, S., dolomite deposit, San Luis Obispo Co. 420
Aurora Claim, Siskiyou Co. 288
Austin Group, Mariposa Co. (see Golden Key Mine)

Page
Averill, Chas. V., 111, 255, 401
  , cited 256, 261, 274, 276, 286
B. and M. Mine, Mariposa Co. 28, 38
Badger Mine (Prescott), Mariposa Co. 29
Baher Ranch, Mariposa Co. 46
Bailey Mine, Siskiyou Co. 314
Baja (Lower) California 117
Bajada placers 145, 161
Baker Divide Co. 19
  Mine, Placer Co. 314
Baldwin Group Mines, Siskiyou Co. 314
Balfrey Mines, Siskiyou Co. 274, 314
Ball and Goforth Mines, Siskiyou Co. 314
  Mine, Siskiyou Co. 314
  Ranch chromite deposit, Siskiyou Co. 269
Ballena Placer 153
Ballingal Placer Mine, Siskiyou Co. 314
Banana Chrome Claim, San Luis Obispo Co. 412
Bandarita (Bandaretta) Property, Mariposa Co. 46
Bank Mine, San Luis Obispo Co. (see also Cambria Mine) 435
Banks and Maginnis, Inc., Mines, Siskiyou Co. 314
Banner Claim, Siskiyou Co. 283
  Mine, Siskiyou Co. 314
  Mines, Nevada Co. 13, 17
Barandun Mine, Siskiyou Co. 314
Barbara Claim, San Luis Obispo Co. 417
Barite in Mariposa Co. 46
  San Luis Obispo Co. 410
Bark House Creek Placer Mine, Siskiyou Co. 314
Barney Kane prospect, Mariposa Co. 29
Barrett Mine, Mariposa Co. 29
Barton and Barnham limestone deposit, Siskiyou Co. 332
  copper claims, Siskiyou Co. 271
Barytes, statistics of production 221
Beach placer, diagram of cross-section of, Fig. 15-B, 164
  placers 163
    in Alaska, diagrammatic cross-section of formation of Fig. 15-A, 164
  sands, photograph of placer mining in 163
Bear Den Mine, Siskiyou Co. (see Snowflake and Little Gem Mine)
  River, hydraulic mining on 350
Beaudry Placer Mine, Siskiyou Co. 314
Beauty Mine, Placer Co. 17
Bedrock, release of gold from 196
Belle Josephine Placer Mine, Siskiyou Co. 314
Belt Mine (see Jacks or La Libertad Mine)
Bender Mines, Siskiyou Co. 314
Benn and Smith claims, Monterey Co. 463
Bennett-Pate Ranch, Mariposa Co. 46
Benton Ranch chromite deposit (see Fitzhugh Ranch deposit)
Bentonite, statistics of production 222
Berkey, Charles P., cited 173
Berry Creek Mine, Butte Co. 6
  Mine, Siskiyou Co. (see Evans Placer Mine)
Best Chance Mine, Sierra Co. 4
Better Yet Mine, Siskiyou Co. 314
Bibliography of California placers 201
Big Bend Claim, San Luis Obispo Co. 417
    Placer Mine, Siskiyou Co. 314
  Bug Claim, San Luis Obispo Co. 442
  Canyon (Oro Fino) Mine, El Dorado Co. 22
  Chief Mine, Placer Co. 20
  Cliff Mine, Siskiyou Co. 314
    Property, Siskiyou Co. (see also Winterings Mine) 274
  Dick Property, Mariposa Co. (see Bunce)
  Flat Placer Mine, Siskiyou Co. 314
  Grizzly Property, Mariposa Co. 46
  Ledge Mine, Siskiyou Co. 314
  Rock Placer Mine, Siskiyou Co. 314
  Slide Placer Mine., Siskiyou Co. 314
Billups Mine (Cleland, Brown and Billups), Siskiyou Co. 314
Bishop's Peak Quarry, San Luis Obispo Co. 459
Bitterwater Spring, San Luis Obispo Co. 428
Bituminous rock in San Luis Obispo Co. 411
Black Bear Consolidated Mining Co. 20
    Mine, Nevada Co. 11
    Quartz Mine, Siskiyou Co. 274, 315
  Dike and Blue Eagle Groups, Siskiyou Co. 274–275, 315
  Eagle Claim, San Luis Obispo Co. 460–461
  Hawk Mine, San Luis Obispo Co. (see Polar Star Mine), Siskiyou Co. 315
    , Hidden Treasure, Triangle Mine, Siskiyou Co. 315
  Lead Mine, Siskiyou Co. (see, also, Blue Gravel Placer) 315
  Mountain Volcanics of Southern Peninsular Range of California 116, 121, 122, 125, 126, 131

Page
Black Oak Property, Mariposa Co. 46
   Rock Placer Mining District, Nevada Co. 10
      tin deposit, Riverside Co. 516
   Wolf Placer Mine, Siskiyou Co. 315
Blackwelder, Eliot, cited 161, 162, 185, 191
Blake, W. P., cited 117, 489
Blaylock & Schon Placer Mine, Siskiyou Co. 315
Blind Lode Mine, Siskiyou Co. 315
Bloomer Placer Mine, Siskiyou Co. 315
Blue Bar Placer Mine, Siskiyou Co. 274, 314
   Bell Claim, Siskiyou Co. 283
   Channel Placer Mine, Siskiyou Co. 315
   –Eagle–Cactus Queen, development of vein, Kern Co. 469
      Mine, Kern Co. 469–470
   Gravel Claims, Siskiyou Co. 275
      Mine, Siskiyou Co. 258, 275
      Placer Mine, Siskiyou Co. (see, also, Black Lead) 315
   Hill Mine, Siskiyou Co. 315
   Horn Mine, Siskiyou Co. 275, 315
   Jay Mine, Monterey Co. 463
      , Siskiyou Co. 261, 315
   Jeans and Cub Bear Mines, Siskiyou Co. 317
   Lead Mine., Siskiyou Co. 315
      Mining Co. 6
   Ledge Copper Mine, Siskiyou Co. 261, 271
   Mine, Siskiyou Co. 315
   Nose Placer Mine, Siskiyou Co. 315
   Point Mine, Yuba Co. 7
Bonaly Mine, Siskiyou Co. (see Shumway Placer Mine).
Bonanza and Contact Mines, Siskiyou Co. 317
   Claim, Mariposa Co. 42
      , San Luis Obispo Co. 417
   Mine, Siskiyou Co. 315
Bondarant Property, Mariposa Co. 46
Boot Placer Mine, Siskiyou Co. 315
Bootjack, Osgood or Channel Mine, Butte Co. 6
Borates, statistics of production 222
Böse, E., and Wittich, E., cited 131
Boss Mine, Siskiyou Co. 301, 315, 328
Bouck property, Placer Co., gold on 17
Bouery, Pierre, cited 362, 363
Boulder Creek Placer (Fippen & Hayden), Siskiyou Co. 315
   Dam 173
   Mine, El Dorado Co. 22
      , Siskiyou Co. 315
   Park 130
   Point Placer Mine, Siskiyou Co. 315
Boulevard 129, 133, 134
Bowersox Placer Mine, Siskiyou Co. 315
Bowie, A. J., Jr., cited 351, 353, 356
Bowser Mine, Siskiyou Co. 275–276, 315
Boyle Mine, Siskiyou Co. 258, 315
Bradley, Walter W. 100, 220, 336, 345–367, 385, 526
Brazil Placer Mine, Siskiyou Co. 315
Breccia, photograph of andesite 165
Brewery Mine, Monterey Co. 463
Brooklyn Mine, Monterey Co. 463
Brooks, Alfred H., cited 156, 169, 171
Brown & Billhaps, Siskiyou Co. 315
   and George Placer Mine, Siskiyou Co. 315
   Bear Mine, Siskiyou Co. 315, 316
   Mine, Siskiyou Co. 314
   Ranch feldspar and silica deposit, Riverside Co. 521
Browne, Ross E., cited 146, 352, 353, 361
Brunswick Mine, Nevada Co. 11
Buckman Lithia Springs 116, 118, 123, 124, 125, 133, 135, 141
Buclimo Mine, Monterey Co. 463
Budan Springs, San Luis Obispo Co. 430
Buena Vista Claim, San Luis Obispo Co. 412
      Mine Map, San Luis Obispo Co. facing page 442
         , San Luis Obispo Co. 442
Buffalo Mine, Mariposa Co. 29
Bullard's Bar Dam, North Fork of Yuba River, photograph 365
Bulldog Mine, Mariposa Co. (see Permit Mine)
Bull Dog Placer Mine, Siskiyou Co. 315
Bullion Consolidated Mine, Nevada Co. 11
   Mountain District, Siskiyou Co. 261
Bully Boy Group, Madera Co. 24
Bumblebee Mine, Siskiyou Co. 315
Bumble Bee Placer Mine, Siskiyou Co. 315
Bunce (Big Dick) Property, Mariposa Co. 46
Bunker Hill Drift Mine, Sierra Co. 3
Burchfield, B. M., cited 53
Buried Channel 166

Page
Burns Placer Mine, Siskiyou Co. 315
Burton-Brite-Blank Property, Kern Co. 469, 471
Burton limestone deposit, Siskiyou Co. 332
  Mine, Siskiyou Co. 315
Buschow Lumber Co. 275
Bushnell Mine, Monterey Co. 463
Bush, R. D. 88, 211, 340, 522
Buster Claim, Siskiyou Co. 283
Butcher Ranch chromite deposit, Siskiyou Co. 269
Butte Co., gold mining in 4
Buzzard copper mine, Siskiyou Co. 272
  Hill Mine, Siskiyou Co. 259, 316
  , Inc., Siskiyou Co. 276, 288–289
C. B. & Q. Mine, Siskiyou Co. 316
Cactus Queen Mine, Kern Co. 471–472
Cady, C. C., asbestos prospect, Siskiyou Co. 264
Caen Quarry, San Luis Obispo Co. 459
Cajalco Mine, Riverside Co. 515
  quartz monzonite 502
California Bar Placer Mine, Siskiyou Co. 316
  Barite Corp., Ltd. 46
  Consolidated Mine (Gold Ball), Siskiyou Co. 316
  Debris Commission, cited 345, 360, 361
  , geologic conditions in the gold provinces of 193
  Group of Claims, Nevada Co. (see Normandy)
  , Physiographic map of 152
  , preliminary legend of new geologic map of 113
  -Sierra Gold Mines, Inc. 11
Californite (Jade) in King Jade Quartz Mine, Siskiyou Co. 291
  in Siskiyou Co. 279, 291, 333
Cal Oro Dredging Co. (see also Gardella Dredge), Siskiyou Co. 316
Cambria Mine, San Luis Obispo Co. 435
Cambrian 114
Cameron Valley 131, 136
Cameta Warm Spring, San Luis Obispo Co. 428
Caminetti Act of 1893 154, 345
Campbell Placer Mine, Siskiyou Co. 316
Campo 134
Canada Hill Mine, Nevada Co. 11
Cannon Mine, Siskiyou Co. 316
Canyon Creek Dredger, El Dorado Co. 22
  , photograph of ancient river terraces of 154
Cape Cod Mine, Siskiyou Co. 316
Capital Dredging Co. 21
Capitola Claim, San Luis Obispo Co. 437
Carboniferous 114
Cariboo Mine, Siskiyou Co. 316
Carl & Shaw Mine, Siskiyou Co. 316
Carlock Mine, Siskiyou Co. 258
Carrie Todd Claim, Mariposa Co. (see Texas Hill Mine)
Carpenter & Robertson Placer Mine, Siskiyou Co. 316
Carpentier, A. 459
Carson Mine (see Klau Mine)
Cartwright & Phillips Mine (Mountain Belle), Siskiyou Co. 316
Casey Mine (see Klein Placer Mine)
Cassadoga Mine, Siskiyou Co. 316
Castro Extension Mine, San Luis Obispo Co. 412
  Mine, San Luis Obispo Co. 412
Catskill Mine, Butte Co. 6
Cecilville Placer Mine (Sightman), Siskiyou Co. 316
Cement, statistics of production 222
Cenozoic 113
  Rocks of the Southern Peninsular Range of California 137
Central Consolidated Mines, Nevada Co. 13, 16
  Hill Channel, photograph of 146
  Mines, Siskiyou Co. (see also Union) 276, 316, 328
Challenge Mine, Siskiyou Co. 316
Champion Mine, Siskiyou Co. 316
Chaney, Ralph W., cited 178
Channel Mine, Butte Co. (see Bootjack)
Channels, provinces of in California 152
Chapman Mine, Siskiyou Co. 316
Charter Oak Mine, Siskiyou Co. 316
Chastain chromite deposit, Siskiyou Co. 269
Chenoweth Dredger, Placer Co. 19
Cherry Hill Mine, Siskiyou Co. 276, 316
Chicago Mine, Placer Co. 17
Chief of the Hills Tin Group, Riverside Co. 516
China Creek Placer Mine (Reeve), Siskiyou Co. 316
  Point Placer Mine, Siskiyou Co. 277, 316
Chisholm Mine (see Pine Mountain Group)
Cholame-Parkfield Quicksilver Mine, Monterey Co. 462

Page
Chorro Creek No. 1 Claim, San Luis Obispo Co.----- 412
    2 Claim, San Luis Obispo Co.----- 412
    3 Claim, San Luis Obispo Co.----- 412
Chrome Mine, The, Siskiyou Co. ----- 269
Chromite, analysis of, Seiad deposit, Siskiyou Co.----- 268
    , imports of ----- 223
    in San Luis Obispo Co.----- 411
        Siskiyou Co. ----- 265
    King Mine, Siskiyou Co.----- 266
    , occurrences of ----- 223
    , statistics of production ----- 223
City of Six Quartz Mine, Sierra Co.----- 3
Classic Hill Mine (Placer), Siskiyou Co.-----277, 316, 333
Classification of clays ----- 54
    placers ----- 156
Claughry Mine, Siskiyou Co.----- 316
Clay in Perris Block, Riverside Co.----- 518
    San Luis Obispo Co.----- 415
Claymont clays (see Goat ranch)
Clays of Riverside and Orange counties, geological investigation of----- 51
Clear Creek Mine (see also Davis Mine), Siskiyou Co.----- 272
Clearinghouse Mining Association ----- 39
Cleaver (Brown Bear or Golden & Eveleth) Mine, Siskiyou Co.----- 316
Cleland Mine, Siskiyou Co.----- 316
Cleveland claim, Sierra Co.----- 4
Cloudman, Harold C., cited----- 362
Clyburn Placer, Siskiyou Co.-----277, 316
Coal in San Luis Obispo Co.----- 416
    Siskiyou Co. ----- 269
    , statistics of production ----- 223
Coast, diagrammatic cross-section of-----Fig. 15-C, 164
Cobble Wash, photograph of andesite----- 165
Coggins chromite deposit, Siskiyou Co.-----266, 269
Colby Mine, Siskiyou Co. (see Sturn Mine)
Collateral Mine, Siskiyou Co.----- 316
Collins Mine, Siskiyou Co. ----- 260
    Ranch Placer, Siskiyou Co.-----277, 278, 316
Colorado Mine, Riverside Co. ----- 508
    , San Luis Obispo Co.----- 414
Columbia Group, Nevada Co.----- 13
    Mine, Siskiyou Co.----- 317
Colusa Co., oil field development operations in----- 340
Commercial Claim, Mariposa Co.----- 34
Commodore Mine, Siskiyou Co.-----278, 317
Commonwealth Club of California, cited----- 352
Concentrates tested for gold----- 531
Condensed Mine, Siskiyou Co.----- 317
Condor Group, Monterey Co. ----- 463
Confidence Mining Co.----- 23
Connor Mine, Siskiyou Co.----- 317
Conrod, Geo. W., asbestos samples, Siskiyou Co.----- 264
Consequent streams ----- 187
Consolidated Chemical Co., Pacific Distributing Corp. (see Wm. C. Hay, Ltd.)
    Metals Corp. (see also Anglo-American Mining Corp., Ltd.)----- 443
    Sciwash Mines, Siskiyou Co.----- 317
Contact and Bonanza mines, Siskiyou Co.----- 317
Contouring an ancient surface, usefulness of----- 149
Conzetti Placer Mine, Siskiyou Co.----- 317
Cook, Abel W., Placer Mine, Siskiyou Co.----- 314, 317
Cool Springs Claim, Monterey Co. ----- 464
Cooley Ranch, Siskiyou Co., coal on----- 270
Copper in San Luis Obispo Co.-----416–417
    Siskiyou Co. ----- 271
    Mountain Group (see also Barnum Brothers Copper prespect)----- 271
Corbett Mine, Siskiyou Co.----- 261, 317
Cornish Mine, Siskiyou Co.----- 278
Cory Mine, Siskiyou Co.-----306, 317, 326
Cosmos Mines Development Co.-----278, 285, 317
Cosul Company ----- 287
Cottonwood Valley -----118, 129, 132, 133, 135, 136, 141
Cogwill Quicksilver Mine, Siskiyou Co.----- 336
Cowles Mountain ----- 118
Coyote Mountain ----- 138, 140
    Wells -----115, 116, 140
Craig, H. A., limestone deposit, Siskiyou Co.----- 332
Cramer chromite deposit, Siskiyou Co. ----- 269
Cranberry Group, Mariposa Co. (see Rutherford)
Crapo Placer Mine, Siskiyou Co.----- 317
Crary Mine, Siskiyou Co. ----- 317
    , S. R. (quartz and placer), Siskiyou Co.----- 327
Crawfish Gulch Mine, Siskiyou Co.----- 317
Crawley Mine, Siskiyou Co.----- 317

Page

- Cretaceous 114
  - marine placers 200
  - Sierra Nevadan topography, diagram of (Fig. 30-A) 192
- Criteria, coordination of 180
  - , need for establishment of working 192
- Croesus Placer Mine (Hickey), Siskiyou Co. 317
- Cronin Placer Mine, Siskiyou Co. 317
- Crumpton Mine, Siskiyou Co. 317
- Cub Bear and Blue Jeans Mine, Siskiyou Co. 317
- Cummings Mine, Siskiyou Co. 317, 325
- Current notes of Geologic Branch 112
- Cuyamaca region 117, 120
- Cycle of erosion 186
- Cypress Chrome Mine, San Luis Obispo Co. 414–415
  - Mountain Group, San Luis Obispo Co. 435
- Daffodil Property, Siskiyou Co. 280
- Dairy Farm Mine, Placer Co. 18
- Dams for hydraulic mining debris 345–367
- Dante Muscio manganese deposit, San Luis Obispo Co. 427
- Darton, N. H., cited 131
- David Ledge Mine, Siskiyou Co. 317
- Davidson, George, cited 167
- Davis chromite deposit, Siskiyou Co. 269
  - Consolidated Mines (placer), Siskiyou Co. 278, 279, 317
  - Mine, Siskiyou Co. 260
    - (See Clear Creek Mine and Hiyou Mine)
  - , William Morris, cited 190
- Dawson Pit Mine, Monterey Co. 462
- Day, D. T., cited 164
- Dayton, S. P., Ranch, San Luis Obispo Co. 423
- Debris, dams for hydraulic mining 345–367
- Deep Channel Placer Mine (Taylor & Maplesden), Siskiyou Co. 317
- Deer Lodge Mine, Siskiyou Co. 317
  - Park 137
  - Trail Mine, San Luis Obispo Co. 435–436
- Delhi Mine, Nevada Co. 13
- Del Norte Mine, Siskiyou Co. 317
  - Mining Co. 306
- Delta, diagram of cross-section of 25, 176
  - vertical section of (Fig. 24) 176
- Denny Placer Mine, Siskiyou Co. 317
  - Ranch, Siskiyou Co., coal on 270
- Depleted placers 145
- Deposition of gold in placers 171
  - streams 184
- Depot Hill Hydraulic Mine, Sierra Co. 4
- Descanso granodiorite of the Southern Peninsular Range of California 116, 127
  - Mine 137
- Description of clay deposits of Riverside and Orange counties 62
- Desert processes 148, 191
  - Queen Mine, Kern Co. 474
  - stream valley, diagram of cross-section of 162
- Development of placer deposits, diagram of (Fig. 9-A) 157
  - rich placers, diagram of (Fig. 9-B) 157
- Devonian 114
- Dewey Gold Mines Trust 279–280
  - Mine, Siskiyou Co. 279, 317
- Dexter property, Mariposa Co. 46
  - Ranch, Siskiyou Co., chromite on 269
- Dharma Mine, Placer Co. 20
- Diabase Dike of the Southern Peninsular Range of California 140
- Diana property, Mariposa Co. 46
- Diatomaceous earth in San Luis Obispo Co. 419
  - Siskiyou Co. 274
- Diatomite in Madera Co. 26
- Dick Morris Placer Mine, Siskiyou Co. (see also Joe Ramus Placer) 317
- Dickerson, R. E., cited 58, 81, 489
- Dietrich, W. F., cited 53, 518
- Diller, J. S., cited 146
- Dillon Creek prospects, Siskiyou Co. 272
- Diltz Mine, Mariposa Co. 29
- Discovery work 382–383
- District Mining Engineers, reports of 1, 111, 255, 401
- Dixie Queen Mine, Placer Co. 21
- Dog Bar Site dam for Hydraulic Mining 351
- Doggett Placer Mine, Siskiyou Co. 317
- Dollarite Mine, Siskiyou Co. 317
- Dolman Mine, Mariposa Co. 31, 37
- Dolomite in San Luis Obispo Co. 420
- Donnelly, Maurice, cited 118, 153
- Doolittle Placer Mine, Siskiyou Co. 317
- Doss Mine (formerly Ginaca Mine), Mariposa Co. 32
- Doty Group (see Quien Sabe Group)
- Double Eagle and Little Quartz Mine, Siskiyou Co. 317

Page
Douglas clay pit, Riverside Co. 520
  , photograph of 60
  pit clay, photograph of 66
Doyle property, gold on, Yuba Co. 8
Drainage pattern, diagram of dendritic (Fig. 28-A) 190
  trellis (Fig. 28-B) 190
Dredge, photo of home-made, El Dorado Co. 22
Dredged strip along Yuba River, aerial photograph of 144
Dry placer 152
Dudley, Paul H. 487
  , cited 57, 488
Dull Mine, Nevada Co. (see Empress)
Duncan Mine, Mariposa Co. 32
Dundee Mine, Siskiyou Co. 317
Dunn, R. L., cited 164, 258, 352
Dunnigan Placer Mine, Siskiyou Co. 317
Eagle Bird Mine, Nevada Co. 13
Eakle, A. S., cited 334
Echo Mine, Kern Co. 468, 472
Eckis, R., cited 491
Economic significance of the Tertiary gravels 154
  value of Black Mountain volcanics 122
Edman, J. A., cited 164
Edmundson and Sanford Placer Mine, Siskiyou Co. 326
Efman & Boorse copper prospect, Siskiyou Co. 272
Egenhoff barite deposit, Mariposa Co. 46
Elberta Oil Co. 433
El Cajon 126, 138
El Dorado Co., gold in 22
  Group, Sierra Co. 3
Elephant–Eagle Mine, Kern Co. 469, 472
  Mine, Kern Co. 465, 468
Eli Mine, Siskiyou Co. 318
Eliel, Leon T., cited 147
Eliza Mine, Siskiyou Co. 280, 318
Elizabeth Group, San Luis Obispo Co. 441
  Mine, Mariposa Co. 37
Elk Creek Mine, Siskiyou Co. 318
  Placer Mine, Siskiyou Co. 318
Elliott Creek District, Siskiyou Co. 261
  Mines Co. (Placer) 280, 318
  Placer (Golden Nugget) Mine, Siskiyou Co. 318
  , Roy H., cited 361, 362, 363, 366
Ellis, A. J., cited 117, 119, 121, 138
Ellston Placer Mine, Siskiyou Co. 318
El Oro No. 3 Dredge, Siskiyou Co. 318
El Salto Claim, San Luis Obispo Co. 412
Elsinore 121
Elsinore fault 119
  metamorphic series 493
El Toro clays (see Serrano)
Eluvial placers 158
Empire Bar Placer Mine, Siskiyou Co. 318
  Group, Siskiyou Co. 280–281
  Mine, Nevada Co., photo of Oliver Filters at 14
  , Siskiyou Co. 280–281, 318
  Star Mines Co., Ltd. 10, 13
  Trading Co., Inc. 459
Empress (Dull or Newtown) Mine, Nevada Co. 13
  , Photo of Kraut Flotation Unit 12
Emsco Clay Company 518
Engel, Rene, cited 57, 58, 61, 63, 490
English, Walter A., cited 79, 147, 489
Enterprise Leasing Co. 19
  Mine, Madera Co. 24
  , Siskiyou Co. 318
  Placer, Siskiyou Co. 281, 318
Eocene 114
  Poway conglomerate 116
Eolian Placers 162
Erno Mine (Little Queen Mine)
Erosion, cycle of 186
  , preparation of material removed by 181
Espey Placer Mine, Siskiyou Co. 318
Estelle quartz diorite 502
Eton Mine, Siskiyou Co. 318
Eucalyptus Quarry 132
Eureka and Old Town Claims, San Luis Obispo Co. 413
  W. J. D. (Firebug), Siskiyou Co. 318
  Claim, San Luis Obispo Co. 413
  Mine, Mariposa Co. 32
Evans manganese deposit, San Luis Obispo Co. 427
  Placer Mine (Berry), Siskiyou Co. 318
  Ranch chromite deposit, San Luis Obispo Co. 412

Page
Evening Star, Siskiyou Co. 318, 328
Everill Placer Mine, Siskiyou Co. 318
Ewing, Ed, diatomaceous earth deposit, Siskiyou Co. 274
Existence Claim (placer), Monterey Co. 464
Exposed Treasure Mine, Kern Co. 465, 468, 474
Extension and Reliable Mines, Siskiyou Co. 326
  of Siskiyou Mine, Siskiyou Co. 327
Fabbris-Carpentier Co., Ltd. 459
Facey chromite deposit, Siskiyou Co. 269
Factors of concentration of gold in placers 174
Fagundez Mine, Siskiyou Co. 318
Fairbanks, H. W., cited 117, 120, 131, 138, 153, 403, 489, 499, 505, 506
Fairchild Mine, Siskiyou Co. 318
Fairview Claim, Kern Co. 484
  , Mariposa Co. 42
Fairy Queen Mine, Siskiyou Co. 318
Falcon Mine, Siskiyou Co. 318
Farrington limestone deposit, Siskiyou Co. 332
Fault block, diagram of (Fig. 17) 166
Fawcett Mines Co. (see Pennsylvania Placer Mine, Siskiyou Co.)
Feather River 145
Feldspar, commercial 134
  in Perris Block, Riverside Co. 520
  Mine, Lakeside 134
  , Marden 134
Feliciana Mine, Mariposa Co. 33
Fenton, H. G., Materials Company 122
Fern Mine (see Lone Star)
Ferrell diatonite deposit, San Luis Obispo Co. 419
Fidelity Metals Corp. (see also Schroeder Mine) 307–308, 318
Financing, preliminary mine 215
Finch, R. H., cited 185
Fiock Bros. Quarry, Siskiyou Co. 337
Fippen & Hayden (see also Boulder Creek Placer Mine), Siskiyou Co. 318, 330
Fir Tree Placer Mine, Siskiyou Co. 318
Fire clays 54
Firebug Mine, Siskiyou Co. (see Eureka and W. J. D.)
First Chance Mine, San Luis Obispo Co. (see Skyscraper Mine)
Fitzhugh Ranch chromite deposit, San Luis Obispo Co. 412
  quicksilver deposit, San Luis Obispo Co. 437
Flag Mine, Siskiyou Co. 318
Fledderman Bros. Mine, Siskiyou Co. 281, 318
Flederman chromite deposit, Siskiyou Co. 269
  Lease chromite deposit, Siskiyou Co. 269
Fleetwood and Nannie S. Mine, Siskiyou Co. 318
Flint, cited 181, 184, 185
Florence Claim, San Luis Obispo Co. 417
Flow sheet, Golden Queen Cyanide Plant, Kern Co. 478
  , Pacific Mining Company's Pine Tree and Josephine Mill, Mariposa Co. 42
Forks of Salmon River (Placer) Mine, Siskiyou Co. 319
  Placer Mine, Siskiyou Co. 319
Fort Goff Placer Mine, Siskiyou Co. 319
Fossil leaf, San Luis Obispo Co. 461
Foster Mine, Siskiyou Co. (see also Salmon River Mines Co.) 307, 319
Four Star Mines Group, Kern Co. 474, 475
Francis Cleaner Mine and Golden State, San Luis Obispo Co. 460–461
Frank (Shorty) Lewis Mine, Siskiyou Co. 284
Franke, Herbert A. 104, 247, 392–398, 402, 462, 533
Franklin Placer Mine, Siskiyou Co. 319
Franks and Moncton Mine, Siskiyou Co. 319, 325
Fraser, D. Mc., cited 496
Frasier Canyon, San Luis Obispo Co. 423
Frazier Placer Mine, Siskiyou Co. 319
Fremont Grant, Mariposa Co. 37
French Bar Placer Mine, Siskiyou Co. 319
  Camp Mine, Mariposa Co. 38
  Mine, Mariposa Co. 33, 37
Fresno Co., oil field development operations in 88, 91, 211, 340, 522
Friedana Mine, Monterey Co. 462
Froom Estate Mine, San Luis Obispo Co. 412
Frye Mine, Siskiyou Co. (see Rough and Frye)
Fugler Ranch, San Luis Obispo Co. 410
Fugler's Quarry, San Luis Obispo Co. 459
Furlong Bros. and T. A. Lloyd, chromite deposits, Siskiyou Co. 266
Gabbro 501
Gabriel Mining Co. 29
Gale, H. R., cited 118, 140
Galen Mine, Butte Co. 6
Galena Mine, Siskiyou Co. 319
Gallia Placer Mine (Paddy Cronin), Siskiyou Co. 319
Gamblin Mine, El Dorado Co. 23
Gardella Dredge, Siskiyou Co. (see also Cal Oro Dredging Co.) 282, 319
Gardner & Deming Mine (Placer and Quartz), Siskiyou Co. 319
  , E. D., cited 170
Garretson Springs, Siskiyou Co. 333

Page
Gavilan Mine, Riverside Co. 508–509
Gearhart Placer Mine, Siskiyou Co. 319
Geeshan & Kellner Placer Mine, Siskiyou Co. 319
Gem stones and ornamental stones, Siskiyou Co. 333
Gems, statistics of production 224
General Grant Placer, Placer Co. 20
Genetic classification, clays 56
Geologic Branch 50, 112, 339, 486
    conditions in the gold provinces of California 193
    investigations of the clays of Riverside and Orange counties 51
    map of prevolcanic topography 151
    section across the Southern Peninsular Range of California 115
Geological subjects of California placers, cited 201
Geology of a portion of the Perris Block, Southern California 487
Geomorphology of geologic section across the Southern Peninsular Range of California 118
Geophysical surveying 147
George Mine, San Luis Obispo Co. 437
Georgia Slides, cited 159
Gibson Bar Placer Mine, Siskiyou Co. 319
Gilbert, F. C., cited 182
    G. K., cited 180, 182, 352
Gilfeather Mine, Siskiyou Co. 319
Gillis, J. C., and Raymond, Monterey Co. 463
Gilta Quartz Mine (Gold Hill), Siskiyou Co. 283, 319
Ginaca Mine, Mariposa Co. (see Doss Mine)
Glacial-stream placers 161
Gladding, McBean and Company 518–519
Gloria Claim, San Luis Obispo Co. 418
Goat Ranch or Claymont clays 79
    , photomicrograph of 80
Gold and Nickel Mine, Siskiyou Co. 319
Gold Ball Mine (see also California Consolidated Mine), Siskiyou Co. 319
        Mining Co. 261, 283, 319
    Bank Placer Mine, Siskiyou Co. 319
    Bug Mines, Siskiyou Co. 319
    , concentrates tested for 531
    Dyke Mine, Placer Co. 18
    Hill Mine, Butte Co. 6
        , Siskiyou Co. 319
        Placer Mine, Siskiyou Co. 319
    in Butte Co. 4
      El Dorado Co. 22
      Madera Co. 24
      Mariposa Co. 27
      Merced Co. 46
      Monterey Co. 462
      Nevada Co. 10
      Perris Block, Riverside Co. 507
      Placer Co. 17
      placers 168
          , disposition of 171
          , factors of concentration of 174
          , retention of 171
          , transportation of 171
      Sacramento Co. 21
      San Luis Obispo Co. 420–421
      Sierra Co. 3
      Siskiyou Co. 274
      Stanislaus Co. 48
      Yuba Co. 7
    Lead Placer Mine, Siskiyou Co. 319
    Leaf Mine, Siskiyou Co. 284, 319
        Placer Mine, Siskiyou Co. 319
    Ledge Mining Co., Ltd. 33
    Mines in Siskiyou Co. 274
          the mixed rocks 137
        of Siskiyou Co., map showing locations facing 274
    mining in east-central California, 1934, review of 1
    , original source of 168
    -placer mines in Placer Co. 19
    provinces of California, geologic conditions in 193
    quartz mines in Placer Co. 17
    Reserve Mine, El Dorado Co. (see Pyramid)
    Road Mine, Siskiyou Co. 319
    Run Mines (Hungry Hill), Siskiyou Co. 319
    , sources of, in California 527
    Standard, Inc., Siskiyou Co. 319
Golden Age Mine, Siskiyou Co. 319
    & Eveleth or Brown Bear Mine (see Cleaver), Siskiyou Co. 316, 319
    Center Claim, Siskiyou Co. 319
        Mine, Nevada Co. 13
    Chariot Mine, Riverside Co. 509

Page

- Golden Eagle Mine (Indian Creek), Siskiyou Co. 283, 284, 319
  - Gate Mine, Nevada Co. 16
  - Key Mine (formerly Austin Group), Mariposa Co. 33
  - Nugget Mine, Siskiyou Co. 318
  - Queen Cyanide Plant, Kern Co. 477–479
    - Mine, Kern Co. 469, 475–477
  - Rule Mine and Scott Bar Placer Mine, Siskiyou Co. 319
    - , Siskiyou Co. 261, 319
  - Seal Mine, Siskiyou Co. 319
  - State Mine, San Luis Obispo Co. 460–461
  - West Mine, Siskiyou Co. 319
- Good Claim, San Luis Obispo Co. 412
  - Hope Claim, Siskiyou Co. 284, 319
    - Mine, Riverside Co. 509–511
- Goodale and Marrian Mine, Siskiyou Co. (see Marrian and Goodale)
- Goodenough Mine, Siskiyou Co. 317
  - Mining Co. 278
- Goodhope Mine, San Diego Co. 121
- Goodman Mine, Siskiyou Co. 320
- Goodyear, W. A., cited 117, 118, 120, 489
- Gorda Mine, Monterey Co. 463
- Gordon Placer Mine, Siskiyou Co. 320
- Gould Mine, San Luis Obispo Co. (see Mahoney Mine)
- Grand Central Sulphur Spring, San Luis Obispo Co. 428
  - Victory Mine, El Dorado Co. 23
  - View Claim, Mariposa Co. 34
- Granite dikes 116
  - in Madera Co. 27
    - Siskiyou Co. 330
- Grant Lease chromite deposit, Siskiyou Co. 269
  - , U. S. IV, cited 118, 140
- Grass Valley Bullion Mines, Inc. 11
- Graton, L. C., cited 489
- Grattan Mine (Last Chance), Siskiyou Co. 320, 322
- Gravel Mines, Ltd., Siskiyou Co. 284, 320
- Gray Eagle Mine, Kern Co. 468, 472
    - , Siskiyou Co. 272
  - gravels of the Southern Peninsular Range of California 140
  - Wing Extension Mining Co. 21
- Great Basin region 162, 168, 196
  - Northern Gold Mines, Inc. 15, 336
    - Mine (extension of Siskiyou), Siskiyou Co. 320
  - Valley 173, 198
- Green Mountain Mines, Siskiyou Co. 320
- Green's Bar Placer Mine, Siskiyou Co. 320
- Grey Eagle Mine, San Luis Obispo Co. 460–461
  - , Siskiyou Co. 259
- Grider Placer Mine, Siskiyou Co. 320
- Griffin Onyx Marble Quarry, Siskiyou Co. 334
- Grizzly Gulch Mine, Siskiyou Co. 320
  - Hill Mines, Sierra Co. 4
- Grouse Creek chromite deposit, Siskiyou Co. 269
- Grubstake contracts 383
  - permits 215
  - Placer Mine, Siskiyou Co. 320
- Guadalupe Claim, San Luis Obispo Co. 418
- Guatay Mountain 118
- Guerro Claim, San Luis Obispo Co. 418
- Guiton Molding Sand, San Luis Obispo Co. 432
- Gularte Plant, San Luis Obispo Co. 458
- Gumboot Mine, Siskiyou Co. 285, 320
- Gunning property, Yuba Co., gold on 9
- Guy Ford Group of Mines, Siskiyou Co. (see also Jumbo) 320
- Gypsum in San Luis Obispo Co. 423
  - , statistics of production 224
- Habit of streams 180
- Hadloff Mine, Siskiyou Co. 320
- Hagedorn Ranch, Siskiyou Co., coal on 270, 334
- Halana Mine, Sierra Co. 4
- Haley, C. S., cited 154, 352, 353
  - Placer Mine, Siskiyou Co. 320
- Halstead Mine, Siskiyou Co. (see also Haley Mine) 320
- Hamburg Bar chromite deposit, Siskiyou Co. 269
- Hamilton, Robert M., limestone deposit, Siskiyou Co. 332
- Hammer Placer Mine, Siskiyou Co. 320
- Hammon Dredging Project, Mariposa Co. 46
- Hammond Claims, Monterey Co. 463
  - , John Hays, cited 352, 353–354, 356
  - prospect, Butte Co. 6
- Hanks, H. G., cited 489
- Hanna, M., cited 117, 119, 121, 122, 125, 138, 494
- Hansen Mine, Siskiyou Co. 285, 320
- Happy Home Mine, Siskiyou Co., (see also Maplesden Placer) 320, 323

Page
Haquinius, Eric, cited 147
Harbison Canyon 125, 126, 127
    quartz diorite of the Southern Peninsular Range of California 116, 126
Hard Luck Placer Mine, Siskiyou Co. 320
  Scrabble Mine, Siskiyou Co. 320
    Placer Mine, Siskiyou Co. 320
Harder, E. C., cited 411
Harmony Gravel Mine, Nevada Co. 15
Harrington clay deposit, Riverside Co. 518
    pit, description of clays at 71
    , photograph of clay from 72
Hartstan Mine, Siskiyou Co. 320
Hathaway Limestone Quarry, Siskiyou Co. 331, 332
    Mine, Siskiyou Co. 285, 286, 320
Hay, Oliver P., cited 179
  , Wm. C., Ltd. (formerly Consolidated Chemical Co., Pacific Distributing Corp.) 455–457
Hazel Mine (formerly Jillson), Siskiyou Co. 258, 286, 320
Hearst Ranch, San Luis Obispo Co. 427
Heaton, R. C., Well, San Luis Obispo Co. 428
Hegler Mine, Siskiyou Co. 320
Henrietta Claim, Mariposa Co. 34
Henry Mountains 180
  Wood copper prospect, Siskiyou Co. 273
Herndon Placer Mine, Siskiyou Co. 285–286, 320
Herr Ranch, Siskiyou Co., coal on 270
Hesemeyer Estate, San Luis Obispo Co. 428–429
Heuer Report, U. S. Army Engineer, cited 352
Hewitt Lumber Co. 309
Hibernia Mine, Siskiyou Co. (see also Ninety Mine) 320
Hickey Mine, Siskiyou Co. (see also Croesus Placer Mine) 287, 315, 320
  Placer Mine, Siskiyou Co. 320
Hickox Hydraulic Mine, Siskiyou Co. 320
Hicks Mine, Siskiyou Co. 320
Highland Mines, Siskiyou Co. 320, 321
Hill, J. H., cited 53
  , J. M., cited 153, 463
Hinds, Norman E. A., cited 132, 150, 491
History of development of placers 155
    Mojave Mining District 465
Hi-You Mine, Siskiyou Co. 288, 321
  Placer, Siskiyou Co. 288, 321
Hoag Mine, Riverside Co. 512
Hoboken Mine, Siskiyou Co. 321
Hobson, J. B., cited 352, 353
Hogan Mine, Siskiyou Co. 302, 321
Hoge Mine, Nevada Co. 15
Hoist clay pit, Riverside Co. 520
Holmes Ranch tin deposit, Riverside Co. 516
Home Ticket Drift Mine, Placer Co. 20
Homestake Mine, Siskiyou Co. 302, 321
Honcut Gold Mining Co., Ltd. 6
Honeycomb Claim, Mariposa Co. (see St. Gabriel)
Hooper Hill Mine, Siskiyou Co. (see also Preckel) 321
Hoover, H. C., cited 156
  , T. J., cited 367
Hoozier Hill Placer Mine (Willard Drift), Siskiyou Co. 321
Hope Mine, Kern Co. 468
Hornor, R. R., cited 163
Horse Creek Cinnabar Co., Ltd. 336
  Valley Mine, Sierra Co. 4
Horseshoe Mine, Yuba Co. 9
Hossick and Brown, Siskiyou Co. (see Old Vet and Eclipse Mine)
Howard, Henry, and Reeves Davis Estate, Siskiyou Co. 333
  Mine, Monterey Co. 464
Howland Flat Mine, Sierra Co. 4
Hudson, F. S., cited 117, 120, 121, 125, 493, 495
  River Gold Mines, Ltd. 45
Huer-Huero Springs, San Luis Obispo Co. 429
Huey Hill Placer Mine, Siskiyou Co. 321
  Mine, Siskiyou Co. 288
Hulin, C. D., cited 152, 162, 496
Humboldt Co., oil field development operations in 91
Humpback (Fagundez) Mine, Siskiyou Co. 321
Hungry Hill Mine, Siskiyou Co. (see also Gold Run Mine) 319, 321
Hunter and Downey Mine, Siskiyou Co. 321
  Valley prospect, Mariposa Co. 34
Hunter's Paradise (see Paradise) 303, 321
Hussey property, Nevada Co., gold on 12
Hydraulic Mining Commission of California, cited 352, 359
    mining debris, dams for 345–367
      in Trinity River, photograph of 153
      on American, Yuba and Bear Rivers 350

Page

- Ida Claim, San Luis Obispo Co. (see Little Bonanza Group)
  - Leona Mine, Riverside Co. 508
  - May Mine, Siskiyou Co. 301–302, 321
- Idaho–Maryland Mine, Nevada Co. 15
  - Maryland Mines Co. 10, 11
- Imperial County 115, 117
  - Co., oil field development operations in 88, 211, 340
  - Gold Mining Co. 10
  - Heights Placer Mine, Siskiyou Co. 321
  - Valley 118
- Incello Co. 419–420
- Independence Mine, Siskiyou Co. 259, 288–289, 321
- Index to mineral collection in museum 230
- Indian Creek Mine, Siskiyou Co. 319
  - Girl Mine, Siskiyou Co. 289, 321
  - Hill Mine, Sierra Co. 4
  - Queen Mine, Riverside Co. 512
- Industrial Engineering and Equipment Co. 17
- Insurance Mine, Siskiyou Co. 321
- International Mining and Milling Co. 39
- Inyo Mine, Siskiyou Co. 321
- Iodine, statistics of production 224
- Iowa Hill Gold Mining Co. 20
- Iron Dike Mine, Siskiyou Co. 289, 321
  - Duke Mine, Mariposa Co. 34
  - in San Luis Obispo Co. 423–424
    - Siskiyou Co. 330
- Ironsides Mine, Siskiyou Co. 321
- Isabella Copper Mine, Siskiyou Co. 273
- J. N. P. Mining Co. 336
- Jack Lowden Placer Mine, Siskiyou Co. 321
- Jacks Mine, San Luis Obispo Co. 437
- Jackson Mine, Siskiyou Co. (see also Fleetwood and Nannie S. Mine) 318
- Jacumba Hot Springs 116, 141
  - Mountains 119
  - Valley 118, 129, 138
  - volcanics of the Southern Peninsular Range of California 116, 138, 139, 140
- Jade Claim, Siskiyou Co. 279
- Jamul Mountain 118
- Jarman, Arthur, cited 350, 359, 360, 361, 363, 365, 366
- Jefferson Mine, Yuba Co. (see Pennsylvania Mine)
- Jehova Mine, Siskiyou Co. 321
- Jenkins, Olaf P. 50, 112, 143, 339, 486
  - , cited 175, 179
- Jillson Mine, Siskiyou Co. (see Hazel Mine)
- Jim's Seattle Placer Mine, Siskiyou Co. 289, 321
- Joe Ramus Placer Mine, Siskiyou Co. 317, 321
- Johe manganese deposit, San Luis Obispo Co. 427
  - Ranch chromite deposit, San Luis Obispo Co. 412
- Johnson and China Paul Mine, Siskiyou Co. 321
  - Lewis Group, Siskiyou Co. 289–290, 321
  - , C. H., cited 170
  - , Charles F. 215
  - , Douglas, cited 186
  - , G. Z., pumice deposit, Siskiyou Co. 335
  - , H., asbestos prospects, Siskiyou Co. 264
    - , chromite deposit, Siskiyou Co. 266
- Jolly Joker Mine, Siskiyou Co. (see also Paradise) 303
- Jones clay deposit, Riverside Co. 520
- Josephine Group, San Luis Obispo Co. 437, 441
  - Mine, Madera Co. 25
    - , Mariposa Co. (see also Pine Tree) 37
- Joubert Placer Mine(Peterson), Siskiyou Co. 321
- Julia Mine, Siskiyou Co. (see also Underland Mine) 321
- Julian district 118
  - schist, photograph of 119
    - of Southern Peninsular Range of California 116, 120
- Jumbo Mine, Riverside Co. 512
  - , Siskiyou Co. 290, 320, 321
- Jumper Mine, Mariposa Co. 34
- Juniper and Patricia Mines, Mariposa Co. 34
  - Claim, Mariposa Co. 42
- Jurassic 114, 491
- Jura-Trias 114
- Justice Mine, Riverside Co. 508
- K. C. Mine, Siskiyou Co. 321
- Kanaka Hill Hydraulic Mine, Siskiyou Co. 290, 321
- Kangaroo Mine, Siskiyou Co. 321
- Karl Mine, San Luis Obispo Co. 437
- Karma Mine, Kern Co. 465, 479, 481
- Katie May Mine, Siskiyou Co. 291, 308, 321
- Kay, C. B., Siskiyou Co., sandstone deposit 334
- Kearsarge and Pilot Knob (Midwinter and Modoc), Siskiyou Co. 325
- Keaton Mine, Siskiyou Co. 291, 321
- Keeler, Ralph, cited 374

Page
Kenner, Wm., and Templeton Claim, Monterey Co. 463
Keno Placer Mine, Siskiyou Co. 321
Kenosha Claim, Nevada Co. 16
Kenton Mine, Sierra Co. 3
Kern Co., oil field development operations in 88, 91, 211, 340–341, 522
Kerr, P. F., cited 64
  , W. C., cited 169
Kessler onyx marble deposit, San Luis Obispo Co. 432–433
  Springs, San Luis Obispo Co. 429
Keynote Mine, Siskiyou Co. 321
Keystone Mine, San Luis Obispo Co. 437
Kiernan Mine, Siskiyou Co. 321
King Jade Mine, Siskiyou Co. 321
  Quartz Mine, Siskiyou Co. 291
  Solomon Mine, Siskiyou Co. 321, 322
    , photograph of 158
    Mines Co. 261, 292
  Tut Mine, Siskiyou Co. 294, 322
Kings Co., mineral resources of portions of 462
  , oil field development operations in 89, 92, 212, 341, 523
Kingsland Granite Co. 27
  , photo of plant 26
Kinkaid Mine, Siskiyou Co. 322
Kirkman property, Minnie A., Yuba Co., gold on 9
Kismet Group, San Luis Obispo Co. 453
Klamath Hot Springs, Siskiyou Co. 333
  Mine, Siskiyou Co. 301, 302, 322
  Mountains 132, 145, 150, 154, 168, 197
  Placer Co., Siskiyou Co. 322
    Mining Co. 294
  River 145
    district, Siskiyou Co. 259
    Gold Mining Co. 322
Klau Mine, San Luis Obispo Co. 437–441
  Map, San Luis Obispo Co. 438
Klein Placer Mine (Casey), Siskiyou Co. 322
Klondike Mining and Milling Co. (see also Bonanza) 322
Knopf, cited 181, 184, 185
Knownothing Mine, Siskiyou Co. 260, 296, 322
  Placer Mine, Siskiyou Co. 322
Kockel Mine, Mariposa Co. (see Permit Mine)
Kraut Flotation Unit, Empress Mine, Nevada Co., photo of 12
Laboratory 102, 246, 391, 531
La Borde feldspar deposit, Riverside Co. 521
La Grange Gold Dredging Co. 48
Laguna Mining district 137
  Mountains 118, 119
Laizure, C. McK. 24, 111, 338
La Jolla quadrangle 117, 121, 138
Lakeside 120, 132
  Feldspar Mine 134
Lakeview 121, 125, 127, 128, 134
  quartz-hornblende diorite 502
La Libertad Mine, San Luis Obispo Co. (see Jacks Mine).
La Mesa 115, 116, 121, 122, 132, 138, 141
Landslide, diagram of (Fig. 18) 166
Lango Mine, Siskiyou Co. 322
Lanky Bob and Slim Jim Claims on Whites Gulch, Siskiyou Co. 296, 322
  Claim, Siskiyou Co. 296, 322
La Posta quartz diorite of the Southern Peninsular Range of California 116, 129
  , photograph of 125, 128, 130, 135
  Valley 118, 129
La Primea and La Trinidad Chrome Mines, San Luis Obispo Co. 413
Las Bancas 123
Las Mariposas, Mariposa Co. 37
Last Chance Claim, San Luis Obispo Co. 412
  Mine, Siskiyou Co. 322
    , (Grattan) Siskiyou Co. 322
    , (Stewart) Siskiyou Co. 322
  Property, Mariposa Co. 46
La Trinidad Chrome Mine, San Luis Obispo Co. (see La Primea Mine)
Lava Cap Gold Mining Corp. 13, 16
Lead in Siskiyou Co. 330
Leasing, definition of 368
  System, advantages and disadvantages of 370–371
    as applied to metal mining 368
    , basis of settlement 373
    , bond and lease 369
    , definition of 368
    , historical development of 369–370
    , royalties, bases of settlement 373
    , Sliding-scale system 375
    , split-check system 374
    , terms 372–373

Page
Lee, C. H., cited 117, 121
  Quarry, San Luis Obispo Co. 459
  , Willis T., cited 147
Legend, preliminary, of rock formation units used on new geologic map of California 113
Lehman Mine, San Luis Obispo Co. (see also Fitzhugh Ranch deposit) 437
Le May chromite deposit, Siskiyou Co. 269
Lena Claim, Siskiyou Co. 281
Leon Mine, Riverside Co. 512
Lewis and Johnson Group, Siskiyou Co. 289–290
  , Frank (Shorty) Mine, Siskiyou Co. 284
  Mine, Siskiyou Co. 322
Liberty Bond Group, Siskiyou Co. 273
  Mine, Siskiyou Co. 322
Library 104, 247, 392–398, 533
Life history of streams 180
Lignite in Siskiyou Co. 269
Lima Mine, Siskiyou Co. 322
Lime, statistics of production 224
Limestone in San Luis Obispo Co. 425
    Siskiyou Co. 331
  Mountain, San Luis Obispo Co. 425
  , statistics of production 225
Lincoln, Abe, Placer Mine, Siskiyou Co. 314, 322
  Claim, Mariposa Co. 34
Lindgren, W., cited
  117, 146, 149, 153, 159, 165, 167, 168, 173, 174, 175, 178, 352, 356, 357, 358, 359
Lindley, Curtis H., cited 368
Linton, R., cited 53, 57
List of mineral specimens in museum 230
Lithologic criteria of placers 179
Little Bend Claim, San Luis Obispo Co. 417
  Bonanza Group, San Luis Obispo Co. 441
  Bonsa Mine, Siskiyou Co. 322
  Crumpton Mine, Siskiyou Co. 260, 296, 322
  Gem Mine, Siskiyou Co. (see Snowflake (Bear Den) Mine)
  Maggie Mine, Riverside Co. 512
  Pete Claim, Riverside Co. 513
  Quartz and Double Eagle Mines, Siskiyou Co. 317
  Queen Mine, Siskiyou Co. (see also Morrison and Carlock) 322
Live Oak Mine (Stud Horse Flat Group), Mariposa Co. 34
  Yankee Mine, Siskiyou Co. 322
Livingston and Everton Mine, Siskiyou Co. 322
Lloyd, T. A., & Furlong Bros., Siskiyou Co., chromite deposit 266
Loans to mines by Reconstruction Finance Corp. 95
Local geology of clay deposits, Riverside and Orange Cos. 62, 75, 79, 81
Location of dams for hydraulic mines 351
Lode production, ratio of, placer production to 154
Logan, C. A., 1, 111, 338, 401
  , cited 37, 159, 256, 261
London Chrome Mine, San Luis Obispo Co. 413
Lone Star and Fern Mine, San Luis Obispo Co. 417
  Mine, San Luis Obispo Co. 417
Long Mary Mine, Mariposa Co. 37
  Tom Placer Mine, Siskiyou Co. 322
Longwell, cited 181, 184, 185
Lopez Canyon Group, San Luis Obispo Co. 425–426
Los Angeles Brick Company 520
  Co., oil field development operations in 89, 92, 212, 341, 523
  Field District 49, 111, 338, 465
Los Burros District, Monterey Co. 462
Los Coches Tunnel 127, 136
Los Osos Mine, San Luis Obispo Co. 417
Los Penascos Ranch diatonite deposit, San Luis Obispo Co. 419
Lost Camp Hydraulic Mine, Placer Co. 20
  Channel Mine, Yuba Co. 8
  Emigrant Mine, Placer Co. 18
Louisiana Property, Mariposa Co. 46
Lowden Placer (Ariel Lowden), Siskiyou Co. 297
    (Jack Lowden), Siskiyou Co. 297–298, 322
Lower Ruck-a-Chucky Site, dam for hydraulic mining 351
  Siskiyou Mine, Siskiyou Co. (see New Era Placer Mine).
Luce Marble Deposit, Siskiyou Co. 332
Lucky Bob Placer Mine, Siskiyou Co. 322
  Boy Claim, Riverside Co. 513
    , San Luis Obispo Co. 442
  Jack Claim, San Luis Obispo Co. 417
    Group, San Luis Obispo Co. 415
  Jim Placer and Quartz Claim, Monterey Co. 463
  John Mine, Siskiyou Co. 322
  Strike Mine, Riverside Co. 513
    , Siskiyou Co. 322, 325
Lumgrey Mine, Siskiyou Co. 261, 322
M. M. Mine, Monterey Co. 463–464
McCains Plateau 118

Page
McCann Placer Mine, Siskiyou Co. 323
McCarthy chromite deposit, Siskiyou Co. 269
McClaughry Mine, Siskiyou Co. 323
McCles Claim, San Luis Obispo Co. (see Schneider and McCles Claims)
McConnell Bar, Siskiyou Co. 294, 295, 296, 323
McCook Placer Mine, Siskiyou Co. 323
McCoy, Barney, limestone deposit, Siskiyou Co. 332
, Clarence, limestone deposit, Siskiyou Co. 332
McDaniels marble deposit, Siskiyou Co. 332
McGee, W. J., cited 182
McGuffey Placer Mine, Siskiyou Co. 323
McKeen Mine, Siskiyou Co. 302–303, 323, 325
McKenzie Mine, Siskiyou Co. 323
McKinney Iron Mines, San Luis Obispo Co. 424–425
McKnight clay pit, Riverside Co. 520
-Corona clays 75
, photograph of 77
McKoon Quarry 132
McMahon Placer Mine, Siskiyou Co. 323
Mabel Mine, Siskiyou Co. 322
Machado feldspar and silica deposit, Riverside Co. 521
Mac Kenzie Mine, Sierra Co. 4
Madera Co., diatomite in 26
, gold in 24
, granite in 27
, placers in 26
, volcanic ash in 26
Madre de Oro Gold Mining Co., Ltd. 6
Magnesite in San Luis Obispo Co. 426
Magnesium salts, statistics of production 225
Malloy Mine (Oregonian) Siskiyou Co. 322
Magnitude Mine, Siskiyou Co. 322
Mahoney Mine, San Luis Obispo Co. 442
Malone Mine, Mariposa Co. 36
, Siskiyou Co. 273
Malvina Mine (Melvina), Mariposa Co. 36
Mammoth Claim, Mariposa Co. 42
Magalia Mining Co. 5
Mine, Riverside Co. 513
Manchester Mine, Monterey Co. 463
Manganese in Perris Block, Riverside Co. 515
San Luis Obispo Co. 426–427
Siskiyou Co. 333
Mann & Ross Placer (Reynolds Creek), Siskiyou Co. 323
Manzanita Claim, San Luis Obispo Co. 412
Map of clay pits, Riverside and Orange counties facing 86
Mariposa Co., showing principal gold mines facing 28
Oyler Lode, Mariposa Co. 30
Siskiyou Co., western portion facing 274
Maplesden Placer Mine (Happy Home), Siskiyou Co. 323
Marble in Siskiyou Co. 331
Mountain marble deposit, Siskiyou Co. 332
Springs Property, Mariposa Co. 46
Marden Feldspar Mine 134
Marine terraces, Quaternary 119
Mariposa Commercial and Mining Co. 37
Co., barite in 46
, gold in 27
, map of, showing principal gold mines facing 28
Extension (Rovianik) Mine, Mariposa Co. 38
Mine, Mariposa Co. 38
, Monterey Co. 463
Marquat Estate antimony deposit, San Luis Obispo Co. 410
Marrian and Goodale Mine, Siskiyou Co. 323
Martin, J. D., Oil Co. 433
-McKeen chromite deposit, Siskiyou Co. 269
-Walling Property, Mariposa Co. 46
Mary Alma Placer Mine, Siskiyou Co. 323
Masonic Bar Placer Mine, Siskiyou Co. 323
Masterson chromite deposit, Siskiyou Co. 269
Mat-a-pan Mine, Siskiyou Co. 298, 323
Materials Company, H. G. Fenton 122
Matthes, Francois E., cited 179
Matthews, Philip S. 376–381
Mattie Gold Mining Co. 16
Mattoon Placer Mine (New Hope Mine), Siskiyou Co. 323
May Day Claim, Siskiyou Co. 280
Mayland Mining Co. 261, 323
Melville Mine, Monterey Co. 463–464
Melvina Mine, Mariposa Co. (see Malvina)
Mendell Report, U. S. Army Engineer, cited 352
Mendenhall, W. C., cited 490, 495, 496, 499
Menifee Mine, Riverside Co. 513

Page
Merced Co., gold in 46
, oil field development operations in 213
Dredging Co. 47
Gold Mining Co. 36
Unit, Yuba Consolidated Gold Fields 47
Mercury Mine, San Luis Obispo Co. 442
, Siskiyou Co. 336
Mercury No. 1 Claim, San Luis Obispo Co. 443
2 Claim, San Luis Obispo Co. 443
3 Claim, San Luis Obispo Co. 443
Merrill, Frederick J. H., cited 117, 120, 153, 489
G. P., cited 169
Merry Hill Mineral Well, San Luis Obispo Co. 429
Mertie, J. B., Jr., cited 156, 160
Mescal Claim, San Luis Obispo Co. 413
Mesozoic 114
formations, clays in Riverside and Orange counties 58
rocks of Southern Peninsular Range of California, Earlier 120
Metropolitan Mine, Siskiyou Co. 323
Mexican border 121
Michigan-Salmon Hydraulic Mine (Red Hill), Siskiyou Co. 323
Middle Butte Mine, Kern Co., 481
, photographs of 480
Vein, Kern Co., development of 469
Buttes, Kern Co. 465, 469
Middlemast chrome deposit, San Luis Obispo Co. 413
Midwinter and Modoc Mines, Siskiyou Co. (see Pilot Knob and Kearsarge)
Might, Wm., Mine, Siskiyou Co. 323
Milich Placer Mine, Siskiyou Co. 323
Miller Mine, Siskiyou Co. 323
Placer Mine, Siskiyou Co. 323
, William J. 115
Milne and Reichman chromite deposit, Siskiyou Co. 266
Milner, Henry B., cited 171
Mina Rosalia Mine, Riverside Co. 514
Mine financing in California 376–381
, preliminary 215
Mineral collection in museum, index to 230
production statistics of Siskiyou Co. 262
resources of a portion of the Perris Block, Riverside Co. 507
, San Luis Obispo Co. 404
water in San Luis Obispo Co. 428
Siskiyou Co. 333
Minerals and statistics 101, 221, 386, 527
Recovery Corp., Ltd. 298, 323
Miners Hope (Spread Eagle) Mine, Mariposa Co. 38
Miners' wages, security for the payment of 383–384
Mining activity at Soledad Mountain and Middle Buttes-Mojave Mining District, Kern Co. 465
and Scientific Press, cited 369
Loans by Reconstruction Finance Corp. 95
rights, new laws make radical changes 382–384
Mint Mine, Siskiyou Co. 323
Miocene 113
Missing Link Mine, Riverside Co. 513
Mission Bay 119
Mixed rocks in the Southern Peninsular Range of California 134
Modoc Claim, San Luis Obispo Co. (see Little Bonanza Group)
Moffit, Fred H., cited 163
Mojave Desert 152, 162, 168, 196
Mining District, Kern Co. 465
, claim map of facing 468
Molding Sand in San Luis Obispo Co. 432
Molybdenite in Siskiyou Co. 333
Monarch Mine, Siskiyou Co. 323
Monterey Co., gold in 462
, mineral resources of portions of 462
, oil field development operations in 93, 213, 524
, quicksilver in 462
Montezuma Placer Mine, Siskiyou Co. 323
Monument Peak 119
Moonlight Property, Mariposa Co. 46
Moore, B. H., cited 57
Quarry, San Luis Obispo Co. 459
, R. E., cited 491, 496, 499
tin deposit, Riverside Co. 516–517
Mora Bros. Quarry, San Luis Obispo Co. 459–460
Morena Valley 118
Morgan Bros. 335
Mine, Siskiyou Co. 336
Ranch feldspar and silica deposit, Riverside Co. 521
Morganza Placer Mine, Siskiyou Co. 323
Mormon Bar Mine, Mariposa Co. 38

Page
Morning Star Mine, Mariposa Co. 39
, Siskiyou Co. 323
Placer Mine, San Luis Obispo Co. 421
Morrison and Carlock Mine, Siskiyou Co. 298, 323
Mine, Siskiyou Co. 258
Morro Rock, San Luis Obispo Co. 460
Morton clay deposit, Riverside Co. 520
Mosher and Lowell Mine, Siskiyou Co. 323
Mother Lode, aerial map of 194
, index sketch of 195
Mount Bolivar Mine, Siskiyou Co. 323
Mt. Gains Mine, Mariposa Co. 39
Helix, 121, 126
Hoffman pumice claims, Siskiyou Co. 335
Ophir Mine, Mariposa Co. 37
Shasta Lime Co., Siskiyou Co. 331–332
Mount Vernon Mine, Siskiyou Co. 299, 300, 323
Mountain Belle Mine, Siskiyou Co. (see Cartwright & Phillips)
, Siskiyou Co. 258, 323
Chrome Mine, Siskiyou Co. 266
Copper Co. 22
King Mine, Siskiyou Co. 323
Laurel Mine, Siskiyou Co. 283, 323
Lilly Mine, Siskiyou Co. 323
Spring 120, 123, 124, 125, 131, 139
Mountains, Peninsular 115
Muck-a-Muck Placer Mine, Siskiyou Co. 323
Mud Springs Mine, Madera Co. 25
Mullen Mine, Siskiyou Co. 324
Multum in Parvo Placer Mine, Siskiyou Co. 324
Municipal Baths Springs, San Luis Obispo Co. 430
Munroe, C. H., cited 362, 364, 365
Murchie Mine, Nevada Co. 13
Murray, J. J., asbestos claims, Siskiyou Co. 264–265
, William, and Clara Walter, limestone deposit, Siskiyou Co. 332
Museum 102, 228, 388–391, 530
, index to mineral collection in 230
Musgrave chromite deposit, Siskiyou Co. 269
Mutual Chrome Mine, San Luis Obispo Co. 415
Mystery Mine, Siskiyou Co. 324
Native Son Placer Mine, Siskiyou Co. 324
Natomas Co. 21
Navajo Mines, San Luis Obispo Co. 421
Nebraska Mine, Siskiyou Co. 300, 324
Neil, Ben, Mine, Siskiyou Co. 324
Neilon & Putnam Mine, Siskiyou Co. 324
Nelson Mine (Del Monte), Siskiyou Co. 324
Neocene Placer Mining Co. 4
Nevada Co., gold mining in 10
New Crystal Spring Water Co., San Luis Obispo Co. 430
Era Placer Mine (Lower Siskiyou), Siskiyou Co. 324
Hope Placer Mine (Mattoon), Siskiyou Co. 324
laws make radical changes in mining rights 382–384
London Mine (see London Chrome Mine)
New York Mine, Monterey Co. 464
, Siskiyou Co. 283–284, 300–301, 324
Newberry, J. S., cited 117
Newsome Springs, San Luis Obispo Co. 430
Newtown Mine, Nevada Co. (see Empress)
Neys Spring and Upper Soda Spring, Siskiyou Co. 333
Nicolett Mine, Siskiyou Co. 324
Nieland Mine, Butte Co. 6
Nigger Boy Mine, Siskiyou Co. 301, 324
Head Claim, San Luis Obispo Co. 413
Hill Placer Mine, Siskiyou Co. 324
Ninety Mine (Hibernia), Siskiyou Co. 324
Nolan Gulch Placer Mine, Siskiyou Co. 324
Norcal Mining Co. 261, 301–302, 324
Norcross Chrome Mine, San Luis Obispo Co. 415
Nordheimer Placer Mine, Siskiyou Co. 324
Norma Mine, Siskiyou Co. 302, 324
Normandy, California, South Star and Standard groups of claims, Nevada Co. 16
North central region, Siskiyou Co. 257
Fork site dam for hydraulic mining 351
Star Claim, San Luis Obispo Co. 417
Mine, San Luis Obispo Co. 449
, Siskiyou Co. 324
Mines, Nevada Co. 13
Northern California Dredge Co. 324
Goldfields 298–299, 324
Gold, Inc. (see Morrison & Carlock) 286, 298
Noyes, Assemblyman, cited 362
O. K. Group, Sierra Co. 4

Page
O'Connell Gold Mines, Inc. 302, 324
O'Neill Ranch Placer Mine, Siskiyou Co. 325
Oak Bar Dredge Mine, Siskiyou Co. 324
  Bottom Placer Syndicate 324
Ocean Star Group, Nevada Co. 13
  View Mine, Monterey Co. 464
Oceanic Mine, San Luis Obispo Co. 443–447
  , map of 444
Oceanside 121
Ohio Claim, San Luis Obispo Co. 442
  Mine, Siskiyou Co. 324
Oil field development operations 88, 211, 340, 522
  Shale in San Luis Obispo Co. 432
Old Dominion Mine, Riverside Co. 514
  Gold Claim, San Luis Obispo Co. 412
  Highland Mine, Siskiyou Co. (see also Highland Mine) 320
  Indian Mine, Siskiyou Co. 324
  Town Claim, San Luis Obispo Co. (see Eureka Claim)
  Vet and Eclipse Mine, Siskiyou Co. (see also Hossick and Brown) 324
Oligocene 113
Olive Mine, Siskiyou Co. 324
Oliver Filters, Empire Mine, Nevada Co., photo of 14
Olivine Claim, Monterey Co. 464
One Dollar Claim (quartz), Monterey Co. 464
  Hundred Dollar Mine, Siskiyou Co. 324
Ontario Springs, San Luis Obispo Co 430
Onyx in Siskiyou Co. 334
  marble in San Luis Obispo Co. 432
Ophir Mine, Riverside Co. 513
Orange Blossom Mine, Mariposa Co. 39
  Co., geological investigation of clays of 51
  , oil field development operations in 89, 93, 213, 343, 524
Orcutt Placer Mine, Siskiyou Co. 325
Ordovician 114
Oregon Claim, Monterey Co. 464
  Mine, Siskiyou Co. (see also Hegler and Aldrich) 325
Oregonian Mine, Siskiyou Co. (see also Malloy) 322, 325
Oriental Mine, Sierra Co. 3
  , Siskiyou Co. 325
Original Mine, Mariposa Co. 39
Ornamental and gem stones, Siskiyou Co. 333
Oro Fino Mine, El Dorado Co. (see Big Canyon)
  Grande Mine (Cummings McKeen or Shasta), Siskiyou Co. 325
    Mining Co. 302–303
  Rico Mine (Penon Blanco), Mariposa Co. 40
Orr Group, Mariposa Co. (see Robinson)
Ortega Mine, Mariposa Co. 37
Osceola Mine (Franks and Moncton), Siskiyou Co. 325
Osgood Mine, Butte Co. (see Bootjack)
  , Siskiyou Co. 322, 325
Osmiridium in Siskiyou Co. 334
Otay Mountains 118
Outlook Mine, Siskiyou Co. 308, 325
Overton Mine, Siskiyou Co. 325
Oyler Lode, Mariposa Co., map of 30
  Mine, Mariposa Co. 31, 37
Pabst, A., cited 496
Pacific Clay Products Company 520
  Gas and Electric Co. vs. Liberty Hill mine operators 10
  Mine, Sierra Co. 4
  Mining Co. 33, 37, 40
    Company's Pine Tree and Josephine Mill, flow sheet of 42
Packard, E. L., cited 496
Paddy Cronin Mine, Siskiyou Co. 325
Paine Placer Mine, Siskiyou Co. 325
Paleontologic criteria of placers 177
Paleozoic 114
Palermo Gold Dredging Co. 5
Paradise Flat Placer Mine, Siskiyou Co. 325
  Group, Siskiyou Co. 303, 325
  Mine, Siskiyou Co. 325
Paragon Mine, Placer Co. 20
  Placer Mine, Siskiyou Co. 325
Pardee, J. T., cited 163
Parker Group, Siskiyou Co. 273
  marble deposit, Siskiyou Co. 332
  Mine, Siskiyou Co. 325
Parkfield District, Monterey Co. 462
  Quicksilver Mine, Monterey Co. 462
Paso Robles Hot Springs, San Luis Obispo Co. 430
  Mud Bath Springs, San Luis Obispo Co. 430–431
Patricia Mine, Mariposa Co. (see Juniper)
Patriquin Quicksilver Mine, Monterey Co. 462

Page
Patterson Ranch feldspar and silica deposit, Riverside Co. 521
Paymaster Mine, Siskiyou Co. 325
Pecho Warm Springs, San Luis Obispo Co. 431
Peg Leg Mine, Siskiyou Co. 266
Pegmatite dikes 116, 132
    , photograph of 133
Peninsular Mountains, 115
    range 116, 117
        of San Diego Co. 153
        , cross sections of (Pl. II) 142–143
        , geologic map of (Pl. II) 142–143
Pennsylvania Mine, Siskiyou Co. 325
        , Yuba Co. 8
    Placer Mine, Siskiyou Co. 318
Penon Blanco Mine, Mariposa Co. (see Oro Rico)
Pereira Group, San Luis Obispo Co. 413
Permit Mine, Mariposa Co. 40
Perris Block, Southern California, geology of 487
        , mineral resources of 487
    Mine, Riverside Co. 514
    Mining Company 521
    quartz diorite 501
Persea pseudo-carolinensis, fossil of Miocene age, San Luis Obispo Co. 461
Peters Mine, Siskiyou Co. 325
Peterson Placer Mine, Siskiyou Co. 325
Petro Claim, Mariposa Co. 34
Petroleum in San Luis Obispo Co. 433
Phelan Ranch manganese deposits, San Luis Obispo Co. 427
Phillips and Cartwright, Siskiyou Co. 325
Photography, aerial 147
Physiographic criteria of placers 179
    map of California 152
    terms relating to streams 186
Physiography of placers 147
Pick and Shovel Mine, San Luis Obispo Co. 413, 414
Piedmont Mine, Siskiyou Co. 325
Pilot Knob and Kearsarge (Midwinter and Modoc), Siskiyou Co. 325
    Mine, Siskiyou Co. 325
Pine Grove Mine, Siskiyou Co. 325
    Mountain Group, San Luis Obispo Co. 414, 449
    Tree and Josephine Mill, Mariposa Co., flow sheet of 42
        Mine, Mariposa Co. 40
        Mine, Mariposa Co. 37
        , map showing section in plane of vein 40
    Valley P. O. 120, 124, 127, 128, 133, 134, 135, 136, 137
Pinery property, Siskiyou Co. 257
Pinkham Mine, Siskiyou Co. 325
Pismo Petroleum Corp. 433
Pitt Quicksilver Mine, Monterey Co. (see also Patriquin Quicksilver Mine) 462
Pitts Mine, Siskiyou Co. 325
Placer, Ballena 153
    Co., gold mining in 17
        placer mines in 19
        quartz mines in 17
    Creek operations, San Luis Obispo Co. 422–423
    deposits, diagram of development of (Fig. 9-A) 157
        , modification of 167
    dry 152
    mining in beach sands, photograph of 163
    production to lode production, ratio of 154
    reserves 145
Placers, age of 177
    , Bajada 145, 161
    , beach 163
    , bibliography of, cited 201
        California 201
    , classification of 156
    , Cretaceons Marine 200
    , depleted 145
    , Eluvial 158
    , Eolian 162
    , geological subjects of, cited 201
    , glacial-stream 161
    , gold in 168
    , history of development of 155
    in Madera Co. 26
    , lithologic criteria of 179
    , new technique applicable to the study of 143
    , paleontologic criteria of 177
    , physiographic criteria of 179
    , Pleistocene 200
    , preservation of 165
    , recent 200

Page

Placers, residual 157
  , stream 159
  , structural criteria of 177
  , Tertiary stream 200
Plaskett Mine, Monterey Co. 464
Platinum in San Luis Obispo Co. 433
  Siskiyou Co. 334
Pleistocene 113
  placers 200
Pliocene 113
Plumbago Mine, Sierra Co. 3
Plutonic rocks, sequence and correlation of 503
Poker Flat Dredge Mine, Siskiyou Co. 325
Polar Star Mine, San Luis Obispo Co. 449
Pond Water Placer Mine, Siskiyou Co. 325
Porphyry Dike Mine, Siskiyou Co. 325
Porter Mine, Butte Co. 6
Porters Bar Dredging Co. 325
Potrero Valley 118
Portuguese Hydraulic Mine, Siskiyou Co. 298
  Placer Mine, Siskiyou Co. 325
Poverty Hill Mine, Sierra Co. 4
  Point Mine, Siskiyou Co. 325
Poway conglomerate of the Southern Peninsular Range of California 137, 153
Preckel Mine, Siskiyou Co. (see Hooper Hill Mine)
Pre-Cretaceous rocks, undifferentiated 114
Preliminary mine financing 215
Preparation of material removed by erosion 181
Prescott Mine, Mariposa Co. (see Badger)
Preservation of placers 165
Prevolcanic topography, diagram of geologic map of 151
Pride of Mojave Mine, Kern Co. 481–482
Prince Bismark Quartz Claim, Monterey Co. 464
Princeton Mine, Mariposa Co. 38
Probert, Frank H., cited 364
Prodigal Son Claim, San Luis Obispo Co. 419
Prospect Hill Mine, Siskiyou Co. 325
Proterozoic 114
Providence Claim, Monterey Co. 464
  Mine, Siskiyou Co. 325
Provinces of ancient channels in California 152
Pumice and volcanic ash, statistics of production 226
  in Siskiyou Co. 335
Pumpelly, Raphael, cited 169
Punch Creek Mine, Siskiyou Co. 325
Putnam and Neilon Mine, Siskiyou Co. 324
Pyramid (Gold Reserve) Mine, El Dorado Co. 23
Quail Mine, Mariposa Co. 42, 46
Quarry, Eucalyptus 132
  , McKoon 132
  , Simpson-Pirnie 132
Quartz Gulch Placer Mine, Siskiyou Co. 325
  Hill Mine, Siskiyou Co. 303, 325
    , photograph of 158
  , statistics of production 226
Quaternary 113, 491
  marine terraces 119
  volcanic rocks, photograph of 139
Queen Bee Mine, San Luis Obispo Co. 421–422
  Esther Mine, Kern Co. 465, 468, 482
  Lil Mine, Nevada Co. 12
  Mine, Siskiyou Co. 326
  of Sheba Mine, Siskiyou Co. 303, 326
Quicksilver in Monterey Co. 462
  San Luis Obispo Co. 434
  Siskiyou Co. 336
Quien Sabe Group, San Luis Obispo Co. 449
Race Track Placer Mine, Yuba Co. 9
Raeburn, C., cited 171
Ragged Top Group, Kern Co. 514
Ragon property, Nevada Co., gold on 12
Ragsdale Mine, Madera Co. 25
Rainbow Mine, Siskiyou Co. 326
Rancho Piedra Blanca chrome deposit, San Luis Obispo Co. 413
  Santa Manuela, San Luis Obispo Co. 414
    Rita Mine, San Luis Obispo Co. 414
Ransome, F. L., cited 146
Ratio of placer production to lode production 154
Raymond, R. W., cited 361
Recent 113
  placers 200
Reconstruction Finance Corp., mining loans by 95
Recorder Claim, Mariposa Co. (see also Rex Mine) 31

Page
Recording grubstake contracts 383
Red Bank Mine, Mariposa Co. 43
burning clays 55
Cloud Mine, Mariposa Co. 43
Cross Mine, Yuba Co. 9
Hill Hydraulic Mine, Siskiyou Co. 326
Mine, Siskiyou Co. (see also Michigan Salmon Hydraulic, and Russian Hill Placer Mine) 326
Wing Claim, San Luis Obispo Co. 412
Redding Field District 1, 111, 255, 401
Reed Claim, Siskiyou Co. 280–281
, Ralph D., cited 58, 167, 182
Reeder Mine, Siskiyou Co. 326
Reeve Mine, Siskiyou Co. 260, 316
Ranch Mine, Siskiyou Co. 304, 326
Reeves Davis Estate and Henry Howard claims, Siskiyou Co. 333
Refractory bond clays 55
Refugio Claim, San Luis Obispo Co. 419
Reliable and Extension Mines, Siskiyou Co. 326
Remington Hill Placers, Inc., Ltd. 10
Reno Group, Siskiyou Co. 305, 326
Renown Mine, Siskiyou Co. 326
Reports of District Mining Engineers 1, 111, 255, 401
Republic Gold Mining Co. 13
Residual placers 157
Review of gold mining in east-central California, 1934 1
Rex Mine (Recorder), Mariposa Co. 43
Reynolds Creek Mine (Mann and Ross Placer), Siskiyou Co. 323
Quarry, San Luis Obispo Co. 460
Riccioli manganese prospect, San Luis Obispo Co. 427
Rich placers, diagram of development of (Fig 9-B) 157
Richardson Mine, Siskiyou Co. 260
Placer, Siskiyou Co. 306, 326
, Sidney, Ranch, Siskiyou Co. 334
Rickard, T. A., cited 156
Ricketts, A. C., cited 366
Ridge Claim, San Luis Obispo Co. 418
Ries, H., cited 53
Rinconada Mine, San Luis Obispo Co. 449, 453
River channels, map of Tertiary (Pl. III) 196–197
, diagram illustrating course of 171
, diagram of cross-section of 198
Rivers and Harbors Bill 347
, diagrams of (Figs. 22-A, 22-B, 22C) 173
Riverside Co. 121
, geological investigation of clays of 51
, oil field development operations in 89, 93
Mine, Madera Co. 25
Placer, Siskiyou Co. 306, 326
Roberts Mine, Siskiyou Co. 326
Robinson and Orr Group, Mariposa Co. 43
Gulch Mine, Siskiyou Co. 326
Rock formation units, preliminary legend of 113
Rocks, mixed 134
Rocky Point Placer Mine, Siskiyou Co. 326
Roff Mine, Siskiyou Co. 306, 326
(Cory or Bridger), Siskiyou Co. 326
Rolker, C. M., cited 489
Ronning Mine, Siskiyou Co. 326
Roosevelt Claim, Mariposa Co. 34
Roselip Rock and Sand Plant, San Luis Obispo Co. 458
Ross, C. S., cited 64
Rossi Type Quicksilver Retort 453–455
Rough and Frye Mine, Siskiyou Co. 326
Ready Placer Mine, Siskiyou Co. 326
Rout Mine, Siskiyou Co. 326
Rovianik Mine, Mariposa Co. (see Mariposa Extension)
Roxbury Mine, Siskiyou Co. 257, 326
Ruby Basin Mine, Siskiyou Co. 326
Rulon Placer Mine, Siskiyou Co. 326
Russ chrome deposit, San Luis Obispo Co. 414
Russell, Israel C., cited 180
Placer Mine, Siskiyou Co. 326
Russian Hill Placer Mine, Siskiyou Co. 326
Rutherford and Cranberry Group, Mariposa Co. 43
Rycroft Placer Mine, Siskiyou Co. 326
Ruth Pierce Mine, Mariposa Co. 43
Sacramento Co., gold in 21
, oil field development operations in 89
Field District 1, 111, 338, 401
Safety Chrome Mine, San Luis Obispo Co. (see Pick and Shovel Mine)
Sailor Boy Claim, Kern Co. 475

Page
St. Gabriel and Honeycomb Claims, Mariposa Co. 45
Lawrence Mine, Placer Co. 18
, Siskiyou Co. 326
Louis Mine, Sierra Co. 4
Salmon River District, Siskiyou Co. 260
Mine, Siskiyou Co. 326
Mines Co., Inc. (see also Foster Mine) 307
Salsbury Mine, Siskiyou Co. 309, 326
Salt, statistics of production 226
Salyer Mines, photograph of 160
Sampson, R. J. 49, 111, 338, 465, 507
, cited 162
San Bernardino Co., oil field development operations in 89, 525
Creek chrome deposit, San Luis Obispo Co. 414
Sanborn, Frank 102, 246, 391, 531
San Carpojaro Creek and Arroyo La Cruz chromite deposits, San Luis Obispo Co. 415
Sand and gravel in San Luis Obispo Co. 457–458
, statistics of production 226
Sandall Property, Monterey Co. 464
San Diego Bay 119
Co., oil field development operations in 89
formation 138
Sandstone in Siskiyou Co. 334
San Felipe 117
Sanford and Edmundson Placer Mine, Siskiyou Co. 326
San Francisco Claim, Siskiyou Co. (see also Paradise Group) 303
Field District 24, 111, 338
Jacinto Tin Mining Company 515
Joaquin Co., oil field development operations in 89, 213, 525
Valley, map of 191
Jose Valley Mine, San Luis Obispo Co. 449–453
Luis Brick Works, San Luis Obispo Co. 415–416
Hot Springs, San Luis Obispo Co. 431
San Luis Obispo Co., antimony in 410
, asbestos in 410
, asphalt in 410
, barite in 410
, bituminous rock in 411
, chromite in 411
, clay in 415
, coal in 416
, copper in 416–417
, diatomaceous earth in 419
, dolomite in 420
, geography and transportation 402
, geology of 403
, gold in 420–421
, gypsum in 423
, iron in 423–424
, limestone in 425
, magnesite in 426
, manganese in 426–427
, mineral production 405
resources 404
, water in 428
, molding sand in 432
, oil field development operations in 213, 525
, oil shale in 432
, onyx marble in 432
, petroleum in 432
, platinum in 433
, quicksilver in 433
, sand and gravel in 457–458
, sodium sulphate in 455
, stone industry in 455
, table showing mineral production of 406, 408–409
, topography of 403
, volcanic ash in 460
Miguel Mountains 118
Ramon No. 1 Claim, San Luis Obispo Co. 418
2 Claim, San Luis Obispo Co. 418
3 Claim, San Luis Obispo Co. 418
4 Claim, San Luis Obispo Co. 418
Santa Barbara Co., oil field development operations in 89, 93, 213, 343, 525
Clara Claim, San Luis Obispo Co. 412
Mine, San Luis Obispo Co. (see Polar Star Mine)
Cruz Mine, San Luis Obispo Co. (see Klau Mine)
Fe Mine, Riverside Co. 514
Maria Mine, San Luis Obispo Co. (see North Star Mine)
Monica Claim, San Luis Obispo Co. 437
Rita Grade, San Luis Obispo Co. 460
Rosa Mine, Mariposa Co. 43

Page
Santa Rosa Mine, Riverside Co. 514
  Teresa Mine, Siskiyou Co. 326
  Ysabel Springs, San Luis Obispo Co. 431
Santee 132
San Tomas 131
  Vicente 131
Sauer, C. O., cited 117
Sauerkraut Placer Mine, Siskiyou Co. 326
Sawyer Decision of 1884 154, 366
Scales Placer Mining Co. 4
Schneider and McCles Claim, San Luis Obispo Co. 419
Schroeder Group, Mariposa Co. 44
    Mine, Siskiyou Co. 307–308, 326
Schuler Drift Placer Mine, Siskiyou Co. 326
    Placer Mine, Siskiyou Co. 327
Scioc Mine, Siskiyou Co. 327
Scott Bar 159
    Mine, Siskiyou Co. 327
  Greening Claim, Siskiyou Co. 333
  River Dredging Co. 327
    Region, Siskiyou Co. 257
Security for the payment of miners' wages 383–384
Seiad Creek chrome deposit, Siskiyou Co. 267
  Placer Mines, Siskiyou Co. 297, 327
Serrano manganese deposit, San Luis Obispo Co. 427
  or El Toro clays 81
    , photographs of 82, 83, 84, 85
Seven-Thirty Claim, Nevada Co. 16
Shadows Creek Placer Mine, Siskiyou Co. 327
Shannon, E. V., cited 64
Sharp, Frank, limestone deposit, Siskiyou Co. 332
Shasta Mine, Siskiyou Co. 325
  Springs, Siskiyou Co. 333
  View asbestos prospect, Siskiyou Co. 265
Sheba Mine, Siskiyou Co. (see also Outlook Mine) 308, 327
Sheffield Mine, Siskiyou Co. 327
Shepard, Francis P., cited 167
Shingling, diagram of (Fig. 4-B) 149
Short Bend Placer Mine, Siskiyou Co. 308, 327
  Mine, Siskiyou Co. 327
Shorty (Frank) Lewis Mine, Siskiyou Co. 284
Shumway Placer Mine, Siskiyou Co. 327
Shuster, E. A., cited 147
Sidney Richardson Ranch, sandstone on, Siskiyou Co. 334
Sierra Buttes Mining Co., mill site of, Sierra Co. 4
  Co., gold mining in 3
  Morena Mine, San Luis Obispo Co. (see Klau Mine)
  Nevada, block diagram of (Fig. 30-B) 192
    Mining Corp. 3
  Nevadan topography diagram of cretaceous (Fig. 30-A) 192
Sightman Mine, Siskiyou Co. (see Cecilville Placer)
Silexite dikes 116, 132
Silica, commercial 134
  in Perris Block, Riverside Co. 520
  (sand and quartz), statistics of production 226
Silurian 114
Silver Mine, Sierra Co. 4
  Queen Mine, Kern Co. 468, 475
  Swan Mine, San Luis Obispo Co. (see Lone Star and Fern Mine)
Simpson, E. C., cited 152
  -Pirnie quarry 132
Single Jack Claim, San Luis Obispo Co. 412
Siskiyou Coal and Coke Company 270
  Co. 255
    , asbestos in 264–265
    , californite in 333
    , chromite in 265
    , coal in 269
    , copper in 271
    diatomaceous earth 274
    , geography of 255
    , geology and mineral resources of 256
    , gold in 274
    , granite in 330
    , iron in 330
    , lead in 330
    , limestone in 331
    , manganese in 333
    map, western portion facing 274
    , marble in 332
    Mine, Siskiyou Co. 308, 327
    , mineral production statistics of 262
    , mineral resources of 256

Page
Siskiyou Co., mineral water in 333
, molybdenite in 333
, onyx in 334
, opal in 334
, ornamental and gem stones in 333
, osmiridium in 334
, platinum in 334
, pumice in 335
, quicksilver in 336
, sandstone in 334
, soapstone in 337
, stone industry 337
Dredging Co. 327
Gold Mines Co. 327
Klondike Placer Mine, Siskiyou Co. 327
Lead Mine, Siskiyou Co. 330–331
Metals Co. 308, 327
Mine, Siskiyou Co. 327
Mines & Development Co. 308–309, 327
Co. 327
River Bend Placer Mine, Siskiyou Co. 327
Six-Mile Creek Placer Mine, Siskiyou Co. 327
Sixteen to One Mine, Sierra Co. 3
Skelton Mine, Siskiyou Co. 327
Skyscraper Mine, San Luis Obispo Co. 418
Slate, statistics of production 227
Slide Creek Mine, Siskiyou Co. (see Belle Josephine Placer Mine)
Slim Jim Mine, Siskiyou Co. 296, 327
Sluicing of top gravel on Yuba River, hand, photo 2
Slumway Placer Mine, Siskiyou Co. 327
Small Hope and Arthur Mines, Placer Co. 21
Smeyers Ranch, Mariposa Co. 46
Smith and Benn Claims, Monterey Co. 463
Merria Mine, Siskiyou Co. 327
, J. P., cited 182, 270
Mine, Siskiyou Co. 327
Snelling Gold Dredging Co. 47
Snowflake and Little Gem Mine, Siskiyou Co. 327
Soapstone in Siskiyou Co. 337
Soda Mint Mine, Siskiyou Co. 309, 327
, statistics of production 227
Sodium sulphate in San Luis Obispo Co. 455–457
Solano Co., oil field development operations in 214
Soledad Butte, Kern Co. 465
Extension Mine, Kern Co. 468, 469, 482
Sources of gold produced in California 527
South Block Tin Group, Riverside Co. 517
Star group of claims, Nevada Co. (see Normandy)
Southern Pacific Co., sandstone deposit, Siskiyou Co. 337
Land Co., limestone deposit, Siskiyou Co. 332
Quarry, San Luis Obispo Co. 458
Peninsular Range of California, geologic section across the 115
Souza Ranch chromite deposit, Siskiyou Co. 269
Spears Mine, Siskiyou Co. 301, 327
Specimen Claim, Siskiyou Co. 283
Mine, Siskiyou Co. 327
Specimens, mineral, list of in museum 230
Spencer Mine, Siskiyou Co. 258
Spread Eagle Mine, Mariposa Co. (see Miners Hope)
Spring Hill Mine, Nevada Co. 16
Valley Plant 122
Spurr, J. E., cited 163
Squaw Gulch Placer Mine, Siskiyou Co. 327
Stages of stream development 186
Standard Group of Claims, Nevada Co. (see Normandy)
Staneuch Ranch manganese deposit, San Luis Obispo Co. 427
Stanford Mine, Riverside Co. 514
Stanislaus Co., gold in 48
Star Claim, Mariposa Co. 42
Mine, Siskiyou Co. 327
Starlight Mine, Kern Co. 468, 472
State Highway 124, 125
Mineralogist's Report XXX, cited 465
Statistics of mineral production 101, 221, 386, 527
Steel Mine, Siskiyou Co. 327
Steele Mine, Riverside Co. 514–515
Valley granodiorite 502
Stenshaw Placer Mine, Siskiyou Co. 327
Sterling Gold Mining Co. 283, 327
Mine, Siskiyou Co. 327
Stevenson, David, cited 182

Page
Stewart Mine, Siskiyou Co. (see Last Chance Mine)
  , James D., cited 362, 364, 366
Stockfelth, Geo. A., limestone deposit, Siskiyou Co. 332
Stockton Gravel Mining Co. 257
Stone industry in San Luis Obispo Co. 457
    Siskiyou Co. 337
  quarries in plutonic rocks 132
Storage reservoirs for hydraulic mining debris, map facing 350
Storms, W. H. 146
Stratigraphy of clays, Riverside and Orange counties 57
Stream-bed irregularities, diagram of (Fig. 4-A) 149
  development, stages of 186
  erosion 181
  piracy, diagrams of 188
  placers 159
  sedimentation 148
Streams, consequent 187
  , disposition of 184
  , diagrams of (Figs. 26-A, 26-B) 187
  , habit of 180
  , life history of 180
  , physiographic terms relating to 186
  , subsequent 187
  , transportation of 182
Structural criteria of placers 177
Stud Horse Flat Group, Mariposa Co. (see Live Oak Mine)
Sturn Mine, Siskiyou Co. 327
Subsequent streams 187
Substantial Claim, Monterey Co. 464
Suckers Revenge (formerly American Eagle) Mine, Placer Co. 18
Suction eddy, diagram of formation of (Fig. 22-C) 173
    , position of (Fig. 22-B) 173
Sugar Creek chromite deposit, Siskiyou Co. 269
    Mining and Milling Co. 327
  Hill Mine (quartz and placer), Siskiyou Co. 327
  Pine Mine, Sierra Co. 4
Sulphur Spring, San Luis Obispo Co. 431
Sunderland Mine, San Luis Obispo Co. (see Klau Mine)
Sundown Mine, Siskiyou Co. 328
Sunnyside Placer Mine, Siskiyou Co. 309, 328
Sunset Claim, Mariposa Co 31, 42
  View, San Luis Obispo Co. 453
Sunshine Claim, San Luis Obispo Co. (see Alviso and Sunshine Claims)
    Group, Siskiyou Co. 273
    Mine, Siskiyou Co. 328
Superior Consolidated Mines Co. 289, 328
    Spring Water Co. 431–432
Surcease Mine, Butte Co. 6
Sutherland, J. Clark 51
    , cited 493, 505
Sutter Co., oil field development operations in 90
Swedish American Mining Co. 328
Sweetwater Chrome Group, San Luis Obispo Co. 414
    Mine, Mariposa Co. 45
Symons, Henry H. 101, 221, 386, 527
Table Mountain Claim, Monterey Co. 462
    , diagrammatic geologic cross-section of 193
    formation of the Southern Peninsular Range of California 138
    , photograph of 148
      surface of 197
  showing mineral production of San Luis Obispo Co. 406, 408
    total mineral production of California by substances 387, 388
    yield of gravel at important hydraulic claims in California 462
Taft Mine, Siskiyou Co. 328
Tahoe Treasure gold prospect, Placer Co. 18
Take-a-chance Group, San Luis Obispo Co. 419
Tartaglis Mine, San Luis Obispo Co. 437
Tassajara and Tiptop claims, San Luis Obispo Co. 418
    Group, San Luis Obispo Co. 426
Taylor & Maplesden (see Deep Channel Placer Mine, Siskiyou Co.)
Tecate Mountain 118
Teddy-Avalon Mine, Siskiyou Co. 328
Tehama Co., oil field development operations in 90, 214
Telegraph Mine, Sierra Co. 3
Temescal dacite-porphyry 497
    tin deposit, Riverside Co. 515
    Tin Mine, Riverside Co. 517–518
Templeton Sand Plant, San Luis Obispo Co. 458
Ten Eyck Placer Mines, Inc. 328
Tertiary 113, 491
    Central Hill channel, photograph of 146
    channel, sketch map of 170
    formations, clays, Riverside and Orange counties 58

Page

Tertiary gravels, economic significance of the 154
  river channels, map of (Pl. III) 196–197
  stream placers 200
  , undifferentiated 114
  volcanic rocks, photograph of 139
Testing concentrates for gold 531
Texas Flat Mine, Madera Co. 25
  Hill Mine, Mariposa Co. 45, 46
Thomain Placer Mine, Siskiyou Co. 328
Thomas Placer Mine, Siskiyou Co. 328
Thompson Creek marble deposit, Siskiyou Co. 332
    Mine, Siskiyou Co. 309, 328
  Reid Estate, diatomite on, San Luis Obispo Co. 419–420
Three Pals Property, Mariposa Co. 46
Tickell, F. G., cited 171
Tiger Mine, Siskiyou Co. 328
Tin in Perris Block, Riverside Co. 515
Tiptop Claim, San Luis Obispo Co. (see Tassajara)
Tolman, C. F., cited 161
Topography, San Luis Obispo Co. 403
Toro Claim, Monterey Co. 464
Trail Creek Mine, Siskiyou Co. 328
Transportation of gold in placers 171
Trent lease, Middle Butte Mine, Kern Co., photos of 480
  Vein, development of, Kern Co. 469
Triassic 114, 491
Tropico Mine, Kern Co. 482–484
True Grit Mine, Sierra Co. 4
Trust Buster Mine, Siskiyou Co. 261, 328
Tucker, W. B. 49, 111, 338, 465
  , cited 137, 141, 489
Tulare Co., oil field development operations in 214, 343, 525
Tully feldspar deposit, Riverside Co. 521
Turk Mine, Siskiyou Co. 309–310, 328
Turkey Hill Mine, Placer Co. 20
Turner, H. W. 146
Twan and Hannan Mine, Siskiyou Co. 328
Two and a Half Mine, Siskiyou Co. 328
Uncle Sam Mine, Siskiyou Co. 328
Underland Mine (Julia), Siskiyou Co. 311, 328
Undifferentiated Pre-Cretaceous rocks 114
    Tertiary 114
Union-Central Mine, Siskiyou Co. 301, 302
  Mine, Siskiyou Co. 316, 328
U. S. Army Reports of Chief Engineers, cited 352
  Bureau of Mines, cited 368
  Foreign and Domestic Commerce, cited 222, 223
  Geological Survey, cited 489, 490
  Refractories Co. 419–420
  Weather Bureau, cited 256
Upper Narrows Dam, Siskiyou Co. 350, 351
Valine Ranch, Siskiyou Co., chromite on 269
Vallecito View 119
Vanderburg, W. O. 368
Vein systems and ore bodies, Kern Co. 468
Velocity, diagram of effect of 174
Ventura Co., oil field development operations in 90, 93, 214, 344, 525
Venturi-Type Injector Blower described 447, 449
Vesa Creek Mine, Siskiyou Co. 328
Victoria Mine, Siskiyou Co. 328
Victory Gold Mines Co., Siskiyou Co. 311
  , Siskiyou Co. 328
  Mine, Placer Co. 18
Viejas gabbro-diorite 116
    of the Southern Peninsular Range of California 123
    photograph of 122
  meta-diorite 116
  Mountain 123, 125
  Valley 118, 124, 132
Virginia Mine (Virginia-Belmont), Mariposa Co. 46
  quartz-hypersthene norite 501
  Shay Mine, Riverside Co. 513
Volcanic ash in Madera Co. 26
    San Luis Obispo Co. 460
  , statistics of production 226
  rocks, photograph of 139
Volcano Mine, Siskiyou Co. 328
von Geldern, Otto, cited 361, 362, 363
Vulture Mine, San Luis Obispo Co. 453
W. Y. O. D. Claim, Mariposa Co. 31
Waggoner, W. W., cited 361–362
Walker Claim, Riverside Co. 513
  Placer Mine, Siskiyou Co. (see Two and a Half Mine)

Page
Wall Street Claim, San Luis Obispo Co. 442
Wallberg Mining Co. 9
Wallman Ranch Property, Mariposa Co. 44
Walter, Clara and William Murray, limestone deposit, Siskiyou Co. 332
Wanda Mine, Siskiyou Co. 328
Waring, G. A., cited 141, 489, 490, 493
Warmcastle Soda Springs, Siskiyou Co. 333
Warren Ranch quicksilver deposit, San Luis Obispo Co. 453
Washington, H. S., cited 66
Wasley, W. A., cited 371
Waterloo Mine, Madera Co. 25
Weir Ranch feldspar and silica deposit, Riverside Co. 521
Welsh and Bradley Placer Mine, Siskiyou Co. 328
    Ranch chrome deposit, San Luis Obispo Co. 414
        manganese deposit, San Luis Obispo Co. 427
Webber, Benjamin N., cited 156, 161, 162
Weeks Quarry, Siskiyou Co. 337
Wescoatt Mine, Siskiyou Co. 301, 328
West, H. E., cited 489
    Mines Corp. 11
Whistle Bar Placer Mine, Siskiyou Co. 328
White Bear Mine, Siskiyou Co. 311–312, 328
    Dog Mine, Siskiyou Co. 312
    Elephant Mine, Siskiyou Co. 328
Whitlock Mines Corp. 38
Whitmore Mine, Kern Co. 484–485
    Vein System, Kern Co. 469
Whitney, J. D. 146, 352
Whittaker Mine, Siskiyou Co. 329
Wicks Mine, Siskiyou Co. 329
Wildomar kaolin deposit, Riverside Co. 520
    , description of 72
    , photograph of pit 73, 74, 75
Wiliard Placer Mine, Siskiyou Co. 329
Willard Drift Mine, Siskiyou Co. (see Hoozier Hill Placer)
William Burns Placer Mine, Siskiyou Co. 329
    Tell Mine, San Luis Obispo Co. 453
Williams Mine, Siskiyou Co. 329
    Point Placer Mine, Siskiyou Co. 328
Wilson Bros. Mine, Siskiyou Co. 329
    Placer Mine, Siskiyou Co. 329
    Ranch, Siskiyou Co., chromite on 269
Wimmler, Norman L., cited 156
Winchell, A. N., cited 65
Windeler Placer Mine, Siskiyou Co. 329
Wingate Hill Placer Mine, Siskiyou Co. 312, 329
Winona Group, San Luis Obispo Co. (see Little Bonanza Group)
Winterings Mine, Siskiyou Co. (see also Big Cliff) 329
Wisconsin Claim, Siskiyou Co. 283
Wittenberg Mine, San Luis Obispo Co. 453
Wittich, E., Böse, E. and, cited 131
Wood, Henry, copper prospect, Siskiyou Co. 273
    Mine, Siskiyou Co. 329
Woodfill and Barry Placer Mine, Siskiyou Co. 329
Woodford, A. O., cited 131, 496
Woods and Fehely Mine, Siskiyou Co. 329
Wright and Fletcher Mine, Siskiyou Co. 329
    , W. Quinby, cited 175
Wurst chromite deposit, Siskiyou Co. 269
Wyandotte Gold Dredging Co. 5
Yellow Dog Mine, Kern Co. 485
    Vein System, Kern Co. 469
    Rose Mine, Siskiyou Co. 312–313, 329
Yoakum Tract copper prospect, San Luis Obispo Co. 418
Yolo Co., oil field development operations in 214
Yosemite National Gold Mines Co. 43
You Bet Mining Co. 10
Yuba Consolidated Gold Fields 5, 7, 47
    Co., gold Mining in 7
    River, hydraulic mining on 350
        Power Co., cited 360
Yuma 117
Zarina Mine, Siskiyou Co. 329
Zernitz, Emile, cited 189

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